



SEAFDEC Annual Report 2017



Southeast Asian Fisheries Development Center

SEAFDEC Annual Report 2017



Southeast Asian Fisheries Development Center

Preparation and Distribution of this Document

This SEAFDEC Annual Report 2017 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, collaborating 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.

Bibliographic Citation

SEAFDEC. 2018. SEAFDEC Annual Report 2017. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 116 p

Notice of Copyright

Reproduction of this publication, in whole or in part, by any method or process, without written permission from the copyright holder is prohibited. Applications for such permission with a statement of the purpose and extent of the reproduction desired should be made in writing to:

SEAFDEC Secretariat
Suraswadi Building
Kasetsart University Campus
P.O. Box 1046, Kasetsart Post Office
Bangkok 10903, Thailand.

All rights reserved
©SEAFDEC 2018

EXECUTIVE SUMMARY

The SEAFDEC Annual Report 2017 summarizes the programs of activities undertaken by SEAFDEC throughout the year 2017, in-line with the priority needs and policy directives of the Member Countries conveyed through the SEAFDEC Council and the SEAFDEC Program Committee. The programs in 2017 had been categorized into: 1) Programs under the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) (23 projects); Departmental Programs (8 programs); and Other Programs (1 project). While continuing its efforts to develop fisheries and aquaculture technologies to enhance the contribution of fisheries to food security of the region, SEAFDEC also strengthened its efforts in enhancing regional cooperation to address the priorities and needs of the Member Countries, particularly in combating Illegal, Unreported and Unregulated (IUU) fishing and enhancing the competitiveness of fish and fishery products from the region.

Besides the progress and achievements from the activities carried out by SEAFDEC, the year 2017 was also a very significant year as SEAFDEC celebrated the 50th year of its continued effort in revolutionizing the region's fisheries towards sustainability. During the commemoration of the 50th Anniversary of SEAFDEC on 15 November 2017, the commitment of the Member Countries to continue supporting SEAFDEC in achieving its mandate beyond its 50th year had been strengthened. This was demonstrated during the Special SEAFDEC Council Meeting organized in conjunction with the Anniversary Celebration, when the SEAFDEC Council adopted the "Resolution on the Future of SEAFDEC: Vision, Missions, and Strategies Towards 2030" that provided the right direction for SEAFDEC to pursue.

In 2017, SEAFDEC also continued to strengthen cooperation and partnership with other international and regional organizations, non-member governments, as well as national agencies of the Member Countries that share common interest on the sustainable utilization of the fishery resources. Specifically, SEAFDEC took part in various international fora that have crucial implications to the fisheries sector of the region, ensuring that the specificities of fisheries in Southeast Asia are appropriately addressed, and that the regional policy frameworks of SEAFDEC are harmonized with corresponding international initiatives.

It is envisioned that this SEAFDEC Annual Report 2017 could provide a better view of the roles, activities and achievements of SEAFDEC in supporting the Member Countries in their efforts towards achieving sustainable development of fisheries in the Southeast Asian region.

MESSAGE FROM THE CHAIRPERSON OF SEAFDEC COUNCIL



During the past decade, the fisheries sector of the Southeast Asian region had encountered lots of challenges. While the countries continue to exert efforts to enhance the contribution of fisheries and aquaculture to food security and improved livelihoods of our people, and ensure the sustainable utilization of the fishery resources, we also have to deal with the more pressing requirements from the international community.

The continued efforts of SEAFDEC to address the aforementioned concerns had been recognized by many as its very significant achievement, being a fisheries organization that provides important platform to support close cooperation among the countries in Southeast Asia. This was especially true in the recent years when many issues that need to be addressed require the united and concerted efforts of the Southeast Asian countries. Under its framework, SEAFDEC has made significant strides to address the priorities and needs of the Member Countries, particularly in combating IUU fishing and ensuring the sustainable utilization of the region's marine and inland fishery resources. Besides, the works of SEAFDEC in the aspects of aquaculture and in enhancing the safety and quality of fish and fishery products, it has also made significant progress in addressing a number of emerging issues and challenges. On behalf therefore of all Member Countries, I would like to congratulate SEAFDEC for its progress of work throughout the year 2017. I would also wish to encourage SEAFDEC to continue providing support to the Member Countries for the sustainability of the region's fisheries.

At this juncture, I would also like to take this opportunity to mention one of the particular events in 2017, which is the Celebration of the Fiftieth Anniversary of SEAFDEC. I would therefore wish to thank all the Member Countries for their participation during this significant event, as well as for their contribution toward the development and adoption of the "Resolution of the Future of SEAFDEC Towards 2030" during the Special Meeting of the SEAFDEC Council organized in conjunction with the SEAFDEC Anniversary celebration. I believe that this Resolution would provide the guidance to SEAFDEC with respect to the efficiency and effectiveness of its programs and activities in the years to come.

Furthermore, I would also wish to take this opportunity to express my sincere appreciation once again to my colleagues in the SEAFDEC Council of Directors as well as to the SEAFDEC Secretariat and Departments for extending their utmost support during my term as Chairperson of the SEAFDEC Council. My greatest appreciation is also extended to the relevant international, regional and national agencies and organizations collaborating with SEAFDEC for their unstinting cooperation and collaboration during the past year, which allowed SEAFDEC to implement activities that are beneficial to the countries in the Southeast Asian region. I truly wish that the momentum that SEAFDEC has developed would be sustained in the future.

A handwritten signature in blue ink, appearing to read 'Salleh'.

Mr. Abdul Halidi Mohd. Salleh
Director, Department of Fisheries
Brunei Darussalam

MESSAGE FROM THE SEAFDEC SECRETARY-GENERAL



The year 2017 was another significant year for SEAFDEC as it traversed the half century frontier of its existence in Southeast Asia. As SEAFDEC celebrated its 50th Anniversary in December 2017, it also looked back 50 years ago where it had started. The need of the region during the early establishment of SEAFDEC focused on improving fish production to meet the rising food demand of the region's increasing population. As development set in, this target had shifted towards ensuring the sustainable utilization of fishery resources and conserving the relevant habitats and environment for the future generations. The role of SEAFDEC has to be adjusted to support the Member Countries in their efforts towards sustainable resources utilization. Finally, fifty years after the establishment of SEAFDEC, the region's fisheries production has increased from 5 million to 44 million metric tons annually, sharing more than 20 percent of the global fisheries production.

While sustaining the contribution of fisheries to meet the increasing demand for food fish, SEAFDEC and its Member Countries were confronted with a number of challenges throughout the fishery production chain, either from capture fisheries or aquaculture to the consumers, not only from within the region but also in the international markets. It was therefore a very important task for SEAFDEC to connect all the links, by developing technologies that lead to improved production, ensure the safety and quality of products to meet the consumers' requirements, ensure that the resources are utilized in sustainable manner, while also assuring that the marginalized people engaged in fishery-related activities would get their fair share from the utilization of the resources.

Thus, throughout the year 2017, SEAFDEC continued to implement several programs and projects to fulfill its mandate *"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."* However, such tasks could not have been accomplished without the full support of the Member Countries and collaborating organizations, as well as donor agencies working closely with SEAFDEC. We truly wish that such collaborative spirit would be continued and strengthened in the future. As the SEAFDEC Council has adopted the new *"Resolution of the Future of SEAFDEC Towards 2030"* also in 2017, we would assure our stakeholders that best efforts would be rendered by SEAFDEC for the benefit of the Member Countries in the years to come, especially addressing the priority issues on sustainable development and management of fisheries for the good of all.

A handwritten signature in black ink, appearing to read 'K.S.R.', written in a cursive style.

Dr. Kom Silapajarn
Secretary-General

LIST OF ACRONYMS

ACDS	ASEAN Catch Documentation Scheme
ACIAR	Australian Centre for International Agricultural Research
AFCF	ASEAN Fisheries Consultative Forum
AMAF	ASEAN Ministers on Agriculture and Forestry
AMSS	ASEAN Member States
AQD	SEAFDEC Aquaculture Department
APFIC	Asia-Pacific Fisheries Commission
ASEAN	Association of Southeast Asian Nations
ASSP	ASEAN-SEAFDEC Strategic Partnership
ASWGFi	ASEAN Sectoral Working Group on Fisheries
AVA/PHTC	Post-harvest Technology Centre of the Agri-Food & Veterinary Authority, Singapore
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
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
IDB	Islamic Development Bank
IFRDMD	SEAFDEC Inland Fishery Resources Development and Management Department
IUU Fishing	Illegal, Unreported and Unregulated Fishing
JAIF	Japan-ASEAN Integration Fund
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
NOAA	U.S. National Oceanic and Atmospheric Administration
PSM	Port State Measures
PSMA	Port State Measures Agreement
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
RPOA	Regional Plan of Action
SEAFDEC	Southeast Asian Fisheries Development Center
SOM-AMAF	Senior Officials Meeting of the ASEAN Ministers on Agriculture and Forestry
TD	SEAFDEC Training Department
UNEP	United Nations Environmental Programme
USAID	United States Agency for International Development

CONTENTS

	Page
About SEAFDEC	1
SEAFDEC Council in 2017	3
SEAFDEC Senior Officials in 2017	6
Overview of SEAFDEC Programs in 2017	7
SEAFDEC Programs of Activities in 2017	11
Thrust 1. Developing and Promoting Responsible Fisheries for Poverty Alleviation and Food Security	11
Thrust 2. Enhancing Capacity and Competitiveness to Facilitate International and Intra-regional Trade	45
Thrust 3. Improving Management Concepts and Approaches for Sustainable Fisheries	53
Thrust 4. Providing Policy and Advisory Services for Planning and Executing Management of Fisheries	62
Thrust 5. Addressing International Fisheries-related Issues from a Regional Perspective	79
Special Projects	80
SEAFDEC 50 th Anniversary and its Future Direction beyond 2017	94
SEAFDEC Programs for 2018	100
Cooperation with Donors and Other Organizations in 2017	103
Enhancing SEAFDEC Visibility in 2017	112
SEAFDEC Revenues and Expenditures in 2017	115

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 41st 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.

Since 2007, the Post-Harvest Technology Centre of the Agri-Food and Veterinary Authority (AVA), Singapore (PHTC/AVA) has been serving 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, management, and conservation including 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, establishment of indicators that could be used for the sustainable development and management of transboundary species.



SEAFDEC/MFRDMD

The Inland Fishery Resources Development and Management Department (IFRDMD)

Established in 2014 in Indonesia, IFRDMD is tasked to carry out activities that support the sustainable development and management of inland capture fisheries. The activities of IFRDMD include the 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 2017

Chairpersons of the SEAFDEC Council:

Mrs. Nguyen Thi Trang Nhung (*until March 2017*)

Dr. Tran Dinh Luan (*March-April 2017*)

Mr. Abdul Halidi Mohd. Salleh (*since April 2017*)

SEAFDEC Council and Alternate Council Directors:

Brunei Darussalam

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

Alternate Council Director: **Ms. Ranimah Haji A. Wahab** (*until March 2017*)
Acting Deputy Director, Department of Fisheries
Ms. Mariani Haji Sabtu (*since March 2017*)
Acting Deputy Director, Department of Fisheries

Cambodia

Council Director: **H.E. Eng Cheasan**
Delegate of the Royal Government of Cambodia, and
Director-General, Fisheries Administration

Alternate Council Director: **Dr. Kao Sochivi**
Deputy Director-General, Fisheries Administration

Indonesia

Council Director: **Dr. Sjarief Widjaja** (*until March 2017*)
Secretary-General of Ministry of Marine Affairs and
Fisheries
Mr. Rifky Effendi Hardijanto (*since March 2017*)
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. Shigeto Hase** (*until July 2017*)
Deputy Director-General of Fisheries Agency,
Ministry of Agriculture, Forestry and Fisheries
Mr. Shingo Ota (*since July 2017*)
Councillor, Resource Management Department,
Fisheries Agency,
Ministry of Agriculture, Forestry and Fisheries

Alternate Council Director: **Mr. Keiichi Hara**
Director, First Country Assistance Planning Division,
Ministry of Foreign Affairs



Lao PDR

- Council Director: **Dr. Somphanh Chanphengxay**
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** (*until August 2017*)
Director-General, Department of Fisheries
YH Dato' HJ Munir bin Mohd Nawi (*since August 2017*)
Director-General of Fisheries Malaysia
- Alternate Council Director: **Mr. Zulkafili bin Rashid** (*until August 2017*)
Deputy Director General of Fisheries (Development),
Department of Fisheries
YBrs Mdm Tan Geik Hong (*since August 2017*)
Deputy Director-General of Fisheries (Development),
Department of Fisheries

Myanmar

- Council Director: **Mr. Khin Maung Maw**
Director-General, Department of Fisheries
- Alternate Council Director: **Mr. Myint Zin Htoo**
Deputy Director-General of Department of Fisheries

Philippines

- Council Director: **Commodore Eduardo B. Gongona**
Director of Bureau of Fisheries and Aquatic Resources,
and Undersecretary for Fisheries, Department of
Agriculture
- 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: **Mr. Lim Huan Sein**
Director of Aquaculture Technology Department,
Agri-Food & Veterinary Authority of Singapore

Thailand

- Council Director: **Dr. Adisorn Promthep**
Director-General, Department of Fisheries
- Alternate Council Director: **Dr. Chumnarn Pongsri**
Deputy Director-General, Department of Fisheries

Viet Nam

- Council Director: **Mrs. Nguyen Thi Trang Nhung** (*Acting, until March 2017*)
Deputy Director, Department of Science, Technology and International Cooperation, Fisheries Administration, Ministry of Agriculture and Rural Development
Dr. Tran Dinh Luan (*since March 2017*)
Deputy Director General of Directorate of Fisheries
- Alternate Council Director: **Mrs. Nguyen Thi Trang Nhung**
Deputy Director, Department of Science, Technology and International Cooperation, Fisheries Administration, Ministry of Agriculture and Rural Development



SEAFDEC SENIOR OFFICIALS IN 2017

Secretary-General

Dr. Kom Silapajarn

Deputy Secretary-General

Dr. Kaoru Ishii

Training Department (TD)

Chief

Dr. Kom Silapajarn

Deputy Chief

Dr. Kaoru Ishii

Marine Fisheries Research Department (MFRD)

Chief, MFRD Programmes

Mr. Yeap Soon Eong

Aquaculture Department (AQD)

Chief

Dr. Chihaya Nakayasu (*Acting, until August 2017*)

Dr. Dan D. Baliao (*since September 2017*)

Deputy Chief

Dr. Chihaya Nakayasu

Marine Fishery Resources Development and Management Department (MFRDMD)

Chief

Mr. Raja Bidin Raja Hassan

Deputy Chief

Dr. Osamu Abe (*until March 2017*)

Dr. Kenji Taki (*since April 2017*)

Inland Fishery Resources Development and Management Department (IFRDMD)

Chief

Dr. Arif Wibowo

Deputy Chief

Dr. Satoshi Honda (*until September 2017*)

OVERVIEW OF SEAFDEC PROGRAMS IN 2017

The activities of SEAFDEC in 2017 were formulated and implemented in line with the policy directives given by the SEAFDEC Member Countries during SEAFDEC annual meetings, *i.e.* the 39th Meeting of the SEAFDEC Program Committee (28-30 November 2016, Yogyakarta, Indonesia), 19th Meeting of the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) (1-2 December 2016, Yogyakarta, Indonesia), and the 49th Meeting of SEAFDEC Council (3-7 April 2017, Bandar Seri Begawan, Brunei Darussalam).



SEAFDEC Council Directors attending the 49th Meeting of the SEAFDEC Council hosted by the Government of Brunei Darussalam

The formulation and development of the SEAFDEC programs and activities for 2017 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).

The progress of implementation of the programs and activities implemented by SEAFDEC in 2017 had been considered and endorsed by the 40th SEAFDEC Program Committee Meeting held on 27-29 November 2017 in Bangkok, Thailand and the 20th Meeting of the FCG/ASSP on 30 November - 1 December 2017 also in Bangkok, Thailand, for subsequent submission to the SEAFDEC Council at its 50th Meeting in 2018.



Participants of the 40th SEAFDEC Program Committee Meeting (above) and the 20th Meeting of the FCG/ASSP (below)

Programs and projects implemented by SEAFDEC in 2017:

Program Category/Project Title	Responsible Department	Funding Source
ASEAN-SEAFDEC FCG/ASSP Programs		
Thrust I: Developing and Promoting Responsible Fisheries for Poverty Alleviation and Food Security		
1. Human Resource Development for Sustainable Fisheries	TD	JTF
2. Optimizing Energy Use/Improving Safety Onboard in Fishing Activities	TD	JTF

Program Category/Project Title	Responsible Department	Funding Source
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
7. Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management	MFRDMD	IDB
8. Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia	SEC	JAIF
Thrust II: Enhancing Capacity and Competitiveness to Facilitate International and Intra-regional Trade		
9. 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
10. Cold Chain Management for Seafood	MFRD	Singapore
11. Reinforcement and Optimization of Fish Health Management and the Effective Dissemination in the Southeast Asian Region	AQD	JTF
Thrust III: Improving Management Concepts and Approaches for Sustainable Fisheries		
12. Promotion of Counter Measures to Reduce IUU fishing activities	TD	JTF
13. Combating IUU Fishing in the Southeast Asian Region through Application of Catch Certification for Trading of Fish and Fishery Products	MFRDMD	JTF
14. Establishment and Operation of a Regional System of Fisheries <i>Refugia</i> in the South China Sea and Gulf of Thailand	TD	UNEP/GEF
Thrust IV: Providing Policy and Advisory Services for Planning and Executing Management of Fisheries		
15. Fisheries Resource Survey and Operational Plan for M.V. SEAFDEC 2	TD	JTF
16. Offshore Fisheries Resources Exploration in Southeast Asia	TD	JTF
17. Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region	TD/SEC	JTF

Program Category/Project Title	Responsible Department	Funding Source
18. Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region	MFRDMD	JTF
19. Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region	MFRDMD	JTF
Thrust V: Addressing International Fisheries-related Issues from a Regional Perspective		
20. Assistance of Capacity Building in the Region to Address International Trade-related Issues	SEC	JTF
21. Strengthening SEAFDEC Network for Sustainable Fisheries	SEC	JTF
Special Projects		
22. Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia	SEC	Sweden
23. USAID-SEAFDEC "Oceans and Fisheries Partnership"	SEC	USAID
Departmental Programs*		
1. Quality Seed for Sustainable Aquaculture	AQD	AQD
2. Healthy and Wholesome Aquaculture	AQD	AQD
3. Maintaining Environmental Integrity through Responsible Aquaculture	AQD	AQD
4. Adapting to Climate Change Impacts	AQD	AQD
5. Meeting Socio-economic Challenges in Aquaculture	AQD	AQD
6. Promotion on Strengthening of SEAFDEC Visibility and Image	TD	TD
7. Tailor-made Training Programs	TD	TD
8. Improvement of Fisheries Technology and Reduction of the Impact from Fishing	TD	TD
Other Programs		
1. Application of fish Passage Design Principles to Enhance Sustainability of Inland Fishery Resources in the Southeast Asian region	SEC/TD	ACIAR

* Funding for Departmental Programs is mainly sourced from regular contributions of respective Host Governments.

SEAFDEC PROGRAMS OF ACTIVITIES IN 2017

The programs and activities of SEAFDEC in 2017 were 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 2017 are structured based on the SEAFDEC Program Frameworks and Program Thrusts endorsed by the SEAFDEC Council at its 41st Meeting in 2009, and summarized as follows:

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

1.1 Promotion of Responsible Fisheries for Poverty Alleviation

Under the project “**Human Resources Development (HRD) for Sustainable Fisheries,**” TD has been conducting several regional and national training courses on the application of the Ecosystem Approach to Fisheries Management (EAFM) and on fisheries extension methodologies toward sustainable fisheries development since 2013. Starting 2016, the activities under this project shifted towards the implementation of activities in pilot learning sites. Thahton Township in Mon State, Myanmar was identified as one of the pilot learning sites, and the activity in Thahton focused on improving incomes of fishers through fisheries activities.

To start off the project activities in Myanmar, TD conducted a workshop on 24-26 April 2017 to investigate key stakeholder’s engagement in fisheries and the situation that led to low income of fishers in Thahton Township. Subsequently, a survey was conducted on 18-21 July 2017 to identify the appropriate activities that would lead to increased income for the fisheries community, *e.g.* stock enhancement of mud crab, introduction of responsible and selective traps for catching mud crab, and fish processing activities. Based on the survey results, TD conducted the “Workshop on Development of the Fisheries Management Plan for Thahton Township, Mon State, Myanmar” to strengthen the understanding of the stakeholders on the working processes of developing a management plan. Held from 20 to



Workshop on Development of the Fisheries Management Plan for Thahton Township, Mon State, Myanmar



Participants from Myanmar visiting and observing mud crab culture in Surat Thani Province, Thailand

25 November 2017 in Surat Thani Province, Thailand, the Workshop had five (5) participants from Thahton Township. Besides the development of a Draft Fisheries Management Plan, the Workshop also provided an opportunity for the participants to visit and observe mud crab culture operated by the fisheries communities in Surat Thani Province, which aims to increase the incomes of fishers and which could be adapted by fishers in Thahton Township in the future.

1.2 Habitat Conservation and Resources Enhancement

TD has been implementing the project “**Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia**” since 2015. The project is aimed at obtaining the information on fishery resources enhancement and habitat conservation measures in Southeast Asia; supporting the human resource development for implementing fishery resources enhancement and habitat conservation measures; and promoting good practices on fishery resources enhancement and habitat conservation measures suitable for Southeast Asia.

Fish Aggregating Devices (FADs), one of the resource enhancement tools that had been used in the region based on traditional knowledge of local fishers, varies from community to community and country to country. FADs generally entail lower investment cost compared with other initiatives such as artificial reefs. In addition to its performance in aggregating fishes, FADs also have the potentials to enhance the fishery resources and serve as shelter areas for small and juveniles of various fish species, as well as spawning areas of some aquatic species, *e.g.* squids. Based on the FADs concept and design, TD came up in 2009 with a new design for Fish Enhancing Devices (FEDs), which had been modified by local fishers and now widely used in the coastal provinces of Thailand.

In 2017, TD conducted a survey on the design and construction of FEDs by small-scale fishers in the eastern and western parts of the Gulf of Thailand in order to identify the different designs and construction factors suitable for different localities and fishing grounds. In the eastern part of the Gulf of Thailand, the survey was conducted from 30 October to 5 November 2017 in Chonburi, Rayong, Chanthaburi, and Trat Provinces; while in the western part of the Gulf of Thailand, the survey was conducted from 26 November to 4 December 2017 in Phetchaburi, Prachuap Khiri Khan, Suratthani, Nakhon Sri Thammarat, and Songkhla Provinces. The surveys came up with: 1) a Guide to introduce different designs and factors for FEDs construction and installation, as well as the appropriate management



Collection of data on FEDs around the eastern part of the Gulf of Thailand

for enhancing their effectiveness (types, factors, designs, construction, and management); 2) a Mapping of FEDs installation in important fishing grounds and habitats in the Gulf of Thailand; and 3) a Compilation of references, knowledge, skills and experiences to support capacity building for the promotion of FEDs in Southeast Asia.

The survey on design and construction of FEDs would be continued in 2018 along the coast of the Andaman Sea. The results and lessons learnt from this project would be used to promote the designs and construction of FEDs appropriate for other SEAFDEC Member Countries in the future.

1.3 Coastal Area Capability Enhancement

Completion of the activity under the collaborative project with the Research Institute for Humanity and Nature (RIHN) and other partners on **“Coastal Area Capability Enhancement in Southeast Asia,”** implemented by TD in Rayong Province, Thailand, was capped with the **“International RIHN Final Seminar on Coastal Area Capability Enhancement in Southeast Asia”** on 15 and 17 March 2017 at the Faculty of Fisheries of Kasetsart University, and in Rayong Province, Thailand, respectively. Based on the results, a **“holistic approach”** will be adopted to provide better understanding of how people utilize the coastal resources, and establish rational and practical measures for social and ecological sustainability. About 80 participants from RIHN, SEAFDEC, Kasetsart University, Department of Fisheries of Thailand, fishers and stakeholders attended the RIHN Final Seminar, where the benefits gained by fishers and stakeholders were also presented.



The International RIHN Final Seminar on Coastal Area Capability Enhancement in Southeast Asia

1.4 Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management

The coastal areas in Southeast Asia provide means of livelihood to the coastal dwellers, where hundreds of thousands of coastal families are directly engaged in fishing activities and coastal aquaculture, as well as in related activities such as fish processing, marketing, boat building, net making, and so on. The fishers' over-dependence on the coastal fishery resources has however, led to over-exploitation and degradation of the resources. In addition, the conflict on the multiple resource uses also threatens the livelihood of coastal fishing communities. MFRDMD therefore implemented the one-year project **"Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management,"** starting from 2016 with support from the Islamic Development Bank (IDB). With the main objective of improving the socio-economic status of the coastal community through the community fisheries organization and governance, this project is specifically meant to: 1) enhance the capacity and capability of fishers and women in the fishing community to improve their social well-being and contribute to poverty alleviation; and 2) build the capacity of fishing communities to engage in sustainable livelihoods and improve coastal resource management. The target beneficiaries of this project are the Muslim communities in the region's coastal areas, particularly the countries with the highest Muslim populations, *i.e.* Brunei Darussalam, Indonesia and Malaysia.

To discuss the feedback from the questionnaire on needs assessment survey conducted in 2016 for Brunei Darussalam, Indonesia and Malaysia, 14 training and workshop events were organized by MFRDMD in 2017. A total of more than 370 participants from these three countries took part in the activities that include:

For Brunei Darussalam:

- Training on Basic Maintenance of Yamaha Outboard Motor (9-11 January 2017, DoF Brunei Darussalam), attended by 40 participants (32 fishers including head of community/village and 8 DOF personnel)
- Training on Restoration/Maintenance of Fishing Nets (16-17 January 2017, DoF Brunei Darussalam), attended by 15 participants (12 DOF personnel and 3 fishers)
- Technical Training on Food Processing – Surimi-based Products (23-27 January 2017, DoF Brunei Darussalam), attended by 38 participants (6 DOF personnel and 32 seafood processors including head of community/village)
- Training on Basic Food Hygiene – Good Manufacturing Practices of Fishery Products at Small Medium Enterprises (17-20 April 2017, DoF Brunei Darussalam), attended by 49 participants
- Book Keeping Workshop (4-7 December 2017, DoF Brunei Darussalam) attended by food processors, community head, officials

For Indonesia:

- Internship in Seaweed Processing Enterprises (9-16 April, 2017, Central Lombok District, West Nusa Tenggara, Indonesia), attended by 3 seaweed processors
- Training on Clam-shells Processing (25-26 April, 2017, Takalar District, South Sulawesi, Indonesia), attended by 20 participants
- Workshop for Coastal Resource Management and Regulation of Laikang Village (9-13 October 2017, Makassar, South Sulawesi, Indonesia), attended by 16 participants

For Malaysia:

- Training on Fiberglass Boat Repair (20-21 January 2017, Community Tok Jembal, Terengganu), attended by 20 participants
- Training on Post-harvest Processing – Filleting (series 2) (20-21 January 2017, Community Tok Jembal, Terengganu), attended by 20 participants
- Training on Radio Communication and Safety (14-16 March 2017, Extension and Fisheries Technology Center Seberang Takir, Terengganu), attended by 59 participants
- Helmsman Course (1-3 April 2017, Extension and Fisheries Technology Center Seberang Takir, Terengganu), attended by 59 participants
- Scuba Diving Course (4-7 September 2017, Perhentian Island, Terengganu), attended by 16 participants
- Motivation Course on Welfare of Community Fisherman Family (31 December 2017, Akademi Perikanan Malaysia, Terengganu), attended by 100 participants



Training on safety at sea for fishers



Harvesting seaweeds from pond culture



RTC on Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management



Interview of MFRDMD officers by local reporters during the RTC

MFRDMD also convened the second “Regional Technical Consultation on Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management” on 24-27 August 2017 in Makassar, Indonesia, which was attended by participants from the participating countries, except Brunei Darussalam due to some technical problems. As reported during the Consultation, some activities could not be completed by participating countries in 2017 due to reasons beyond their control, e.g. bad weather. It was therefore suggested that an extension of this project for another 6 months (until June 2018) would be necessary to allow the concerned countries to complete the remaining activities. Thus the

end-of-project Consultation is scheduled to be conducted during the first quarter of 2018 in Brunei Darussalam to conclude the activities and evaluate the results of this project.

1.5 Management for Sustainability of Inland Capture Fisheries

Inland fisheries is one of the most important socio-economic activities of the countries in the Southeast Asian region, and its contribution to the economies of rural communities is particularly important in terms of poverty alleviation, food security and nutritional well-being. The sustainability of inland capture fisheries depends much on the quality of the aquatic habitats and ecosystems. Nevertheless, to enhance the sustainability of inland capture fisheries, it should be recognized that inland water ecosystems are utilized not only by the fishery sector but also by other sectors, a situation that leads to less attention given to inland fisheries.

Taking into consideration the importance of inland capture fisheries in the Southeast Asian region, SEAFDEC/IFRDMD commenced the project **“Promotion of Responsible Utilization of Inland Fisheries in Southeast Asia”** in 2015 with the main objective of promoting and establishing the awareness of stakeholders on the sustainable management of inland fisheries in Southeast Asia. The project has three components, namely: 1) Review of the activities and methodologies for promoting inland fisheries in the AMSs; 2) Promotion of effective inland fisheries management measures in the AMSs; and 3) Development of habitat conservation and resources enhancement measures suitable for the region.

The activities carried out by IFRDMD thus far include collection of data for routine monitoring of different types of inland habitats; and monitoring of the state and levels of exploitation of inland fishery resources in the region. From these activities, the data and information were collected by interviewing concerned fishers, fish collectors, local government officers, as well as researchers from universities; and compiled to provide the scientific basis for proper development and management of inland fishery resources for the Member Countries through direct observation on their inland fishery activities, especially in Malaysia, Philippines, Thailand, and Viet Nam.

For Malaysia, the field survey was conducted in Sabah from 28 August to 2 September 2017 to grasp the present status and recent activities on inland waters, where fishers carry out fishing activities in various types of inland water bodies, *e.g.* rivers, lakes, ex-mining pools, dams, canals, and others. Sabah’s “Tagal” or “Bombon” system prohibits people from catching fish from rivers designated by the community for conservation purposes, except in certain periods when harvest is allowed (usually once a year). This system could be successfully applied to other areas in order to conserve fish that are nearly depleted from the ecosystems, and help in elevating fish production and incomes of local people in the area.

For the Philippines, the field survey was conducted in Taal Lake and Laguna de Bay Lake during 7-13 May 2017. Although the total area of Philippine inland water bodies is comparatively small, only 0.2% of marine water bodies, Philippines has specific nature of inland water bodies that are situated in isolation due to its archipelagic geological condition. The “enumerator system” was therefore introduced and applied to facilitate timely gathering of catch statistics at landing places. This has enabled the Philippines to



Tourist enjoying the recreational facilities of the Tagal System in Sabah, Malaysia



Enumerator recording the data on fish biology in the Philippines

gather reliable data, as well as monitor the state of the fishery resources and their level of exploitation in a timely manner.

As for Thailand, the field survey was conducted during 31 July - 6 August 2017 in Ubon Ratchathani Province located in the northeastern part of Thailand, where statistics on inland fish catch are collected by the enumerators in local markets. Thailand has been conducting studies and experiments on aquatic species in the wild, while re-stocking activities have also been practiced to enhance fish production in reservoirs, *i.e.* culture-based fisheries. Nevertheless, the country generally placed more focus on freshwater aquaculture rather than on inland capture fisheries.

In Viet Nam, the field survey was conducted in coordination with the Directorate of Fisheries at Hanoi, Research Institute for Aquaculture (RIA) No.1 and Hoa Binh Reservoir during 4-7 October 2017. Although inland capture fisheries of Viet Nam plays significant roles in people's lives, the sub-sector has not been given due attention. As a matter of fact, inland capture fisheries has been threatened by environmental degradation (pollution), overexploitation, and poor management practices. The government therefore establishes several sanctuaries to protect key breeding and nurturing habitats, sustain productivity, and conserve biodiversity of the country's inland resources. Nevertheless, Viet Nam is still unable to obtain reliable statistics data due to the small-scale nature of its inland fisheries, and lack of methodologies for data collection. As a result, the country's inland fisheries is often under-valued by decision-makers and the government.



Fishing boat in Hoa Binh Reservoir, Viet Nam



Preparation of inland fishing gear in Thailand

To further enhance the capacity of the researchers of IFRDMD, five in-house trainings were conducted in 2017 at the IFRDMD premises in Palembang, Indonesia. These are: 1) In-house Training on Features of Inland Fisheries in Southeast Asia, on 26-28 April 2017 with the aim of enhancing the knowledge of the staff on how to conduct features study and explore the key issues of inland fisheries in Southeast Asia; 2) In-house Training on Fisheries and Modeling, on 26-28 September 2017 focusing on ocean climate interaction and its inland fisheries impact, fish dynamics population and its recruitment, and spatial and temporal analysis for meteorology and water bodies; 3) In-house Training on Co-management and Rights-based Fisheries, on 7-9 November 2017; 4) In-house Training on Writing the Scientific Publication, on 4-6 December 2017; and 5) In-house Training on Stock Assessment and Fisheries, on 11-13 December 2017.

TD completed in 2017 the implementation of the ACIAR-supported project “**Application of Fish Passage Design Principles to Enhance Sustainability of Inland Fishery Resources in the Southeast Asian Region,**” which was started in 2015 with the objective of designing and constructing an experimental fishway model to support an on-station research on migration of indigenous fishes where different parameters could be controlled and experimented. In 2017, TD continued to improve the experimental fishway model constructed in 2016, primarily to make water velocity passing through the fishway compartments adjustable by varying the slopes from the minimum of 5-degree slope to the maximum of 11 degrees using hydraulic equipment.



Experimental Fishway model in 2017

After finishing the model construction, SEAFDEC organized the “Experimental Research and Meeting Workshop on Vertical Slot Fish Passage Design to Facilitate Migration of Indigenous Fish Species in the Southeast Asian Region” on 4-8 December 2017 in Samut Prakan, Thailand. Based on the results of the experimental trials for several indigenous fish



The slope of fishway model made adjustable from 5 degrees (left) to 11 degrees (right) using hydraulic equipment



The Workshop Session



The Experimental Session

species gathered from the wild, the 2017 fishway model has proven to be practical for the conduct of experiments to gather knowledge on appropriate designs that could facilitate upstream migration of various indigenous fishes of the region.

Although this project has already been completed, during the final research workshop in December 2017, the experts and researchers recommended that there is a need for further works, *e.g.* additional trials using more indigenous fish species and parameters, and that setting-up of fishway model at pilot cross-river obstacles should be initiated to examine the real situation and factors that should be considered in constructing and installing fishways, and ensure that the facility would successfully facilitate migration of the region's numerous indigenous inland fish species. Meanwhile, the facility established at TD could already be used by other countries in the region for conducting joint experiments and capacity building activities in order to obtain better knowledge for designing fishways appropriate for the region.

1.6 Energy Saving and Safety at Sea

The project “**Optimizing Energy Use/Improving Safety in Fishing Activities**” has been implemented by TD since 2013 with the objectives of transferring appropriate knowledge and enhancing awareness on optimizing energy use in fishing activities, and promoting safety at sea for small fishing vessels in the Member Countries. Under this project, TD organized the “Workshop on Appropriate Fishing Vessel Design” on 3-4 July 2017 in Bangkok, Thailand to promote and improve awareness on energy efficiency in fishing

activities. Specifically, the Workshop discussed issues related to reduction of greenhouse gas emission impacts from fishing vessels in Southeast Asia by compiling information on the fishing vessel designs and practices of the Southeast Asian countries. A total of 40 participants representing various fishery associations and relevant stakeholders attended in the Workshop, which came up with the conceptual plan of an appropriate fishing vessel design to support fishing vessel’s operations based on fuel efficiency use, safety at sea, improved good working/living conditions onboard fishing vessels, and reduction of manpower onboard.



Workshop on Appropriate Fishing Vessel Design



Practical Training on Energy Audit for Fishing Vessels

TD also conducted the “On-site Training on Energy Saving and Safety for Small Fishing Vessels” on 3-5 October 2017 in Terengganu, Malaysia for fishers and stakeholders to better understand the concepts of energy saving and safety at sea. The “Technical Handbook on the Energy Saving Measures and Safety Recommendation for Fishing Vessels,” which was translated into Malaysian language, was printed and distributed to the participants, and the stakeholders’ network for safety at sea for small fishing vessels was established.

TD also collaborated with FAO and the Global Environmental Facility (GEF) for the implementation of the project “**Energy Audit for Trawlers in the Gulf of Thailand.**” In 2017, TD in collaboration with FAO/GEF organized the “Practical Training on Energy Audits for Fishing Vessels” from 23 to 27 January 2017 in Samut Prakan Province, Thailand. Attended by 14 participants from Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam, the training comprised three modules, namely: 1) Literature review; 2) Practical demonstration; and 3) Shipboard training at sea for measuring the real-time fuel consumption. At the end of the training, the participants obtained technical knowledge on energy audit for fishing vessels, procedures for measuring the fuel consumptions of trawl fishing vessels in terms of fuel consumption rate, and the parameters for energy audit processes.

In addition, TD also collaborated with the DOF Thailand, the Thai Union Group, and Nestlé Thailand for “**Designing and Construction of Demonstration Boat,**” by making use of the M.V. PLALUNG of TD and modifying it to ensure that the safety, health, work and living conditions of the fishing vessel crew are adequately provided in accordance with the international standards, *i.e.* the Convention Concerning Work in the Fishing Sector (C188). Although fisheries is considered to be among the top professions for Thailand and generates big revenues for people engaged in the sector, the crew working onboard fishing

vessels have been dealing with difficult conditions, minimal safety, inadequate working/living conditions, as well as health and sanitation issues. The M.V. PLALUNG was therefore renovated and equipped with the necessary components to facilitate the need of the crew onboard, *e.g.* kitchen area, mess room, enclosed toilets and shower rooms, sleeping areas, among others. In addition, the boat was also modified to enhance fishing efficiency by installing a “net drum” at the rear of the boat to help minimize the amount of labor used in fishing operations, operating costs, and the speed in casting and retrieving the fishing net.



The M.V. PLALUNG equipped with facilities to improve crews' working condition, and net drum to minimize labor used in fishing operations

1.7 Promotion of Sustainable Aquaculture Development

AQD continues to implement projects that aim to promote the sustainable development of aquaculture in Southeast Asia. Specifically, AQD makes sure that aquaculture techniques and production systems are enhanced towards sustainability, and that aquaculture should be environment-friendly and socially equitable.

1.7.1 Quality Seeds for Sustainable Aquaculture

Success in sustainable aquaculture production depends primarily on the availability of good quality seedstock for rearing to marketable sizes using efficient husbandry techniques under suitable farm conditions. AQD therefore determined the optimal conditions and methods to produce adequate quality seedstock by adopting conventional methods of stock improvement, *i.e.* domestication, broodstock management, strain evaluation and selective breeding or genetic improvement of traditional and emerging freshwater and marine aquaculture species. Biotechnological tools such as DNA markers were used in screening some key aquaculture species to complement the management and selection schemes in genetic improvement. Although genetic intervention can enhance the desired traits in the production of good quality seedstock, *i.e.* improved growth rate, survival, disease and stress tolerance, broodstock and seedstock improvement through nutritional intervention is also considered. Suitable hatchery and nursery protocols are being developed and refined depending on the level of technology for each species.

Broodstock development

Stock characterization using molecular markers was adopted by AQD to determine the genetic quality of hatchery stocks, so that for the genetic characterization of the abalone (*Haliotis asinina*) and mangrove crab (*Scylla serrata*), molecular markers (e.g. mtDNA and/or microsatellite markers) have been used. Nutritional intervention was also carried out to improve the reproductive traits, especially for tiger shrimp, Indian prawn, sandfish, tilapia, and giant grouper while better breeding stocks of these species are also being developed.

For the abalone, six microsatellite or short tandem repeat (STR) DNA markers were used to characterize the existing AQD stocks and nine wild stocks to be used for broodstock genetic assessment. Abalone stocks or strains with high genetic variability implies genetically better or more fit and adaptable. Initial results indicated that the wild stocks from Agusan del Norte (Mindanao) and Palawan (Luzon) had the highest variability based on the number of alleles ($A = 17.8$ and 15.5 , respectively) and expected heterozygosity ($H_{exp} = 0.861$ and 0.901 , respectively). The lowest genetic variability was noted in the stock from Sagay (Visayas) ($A = 5$, $H_{exp} = 0.792$) with the AQD hatchery stock from Iloilo (Visayas) having variability indices that were slightly higher ($A = 8$ and $H_{exp} = 0.872$).

Spawning batches were set up for strain comparison of the abalone in terms of reproductive efficiency. Molecular marker variation data were obtained and correlated with breeding performance. The results showed that the AQD hatchery-bred abalone stocks had the highest number of eggs as well as the number of eggs per gram body weight (BW) of female.



Hatchery-bred abalone breeders

Among the wild abalone, the broodstock from Zamboanga del Sur had the highest fecundity while those from Pangasinan had the most number of eggs/g BW of female, but the stocks from Cebu had the highest larval survival rate. This information and those obtained from the molecular marker variation assessment would be used in the formulation of a broodstock management and selective breeding scheme for the abalone.

For the mangrove crab stocks, genetic characterization based on three novel and three existing STR markers, was carried out to maintain the genetic quality and to check for the negative impacts of domestication in several generations of selected and control stocks from Camarines and Surigao. Initial analysis of the data based on uncorrected estimates of the number of alleles (A) showed that the parental stocks from Camarines and Surigao had 10.17 and 10.33 A , respectively, while two batches of the first generation Camarines control stocks had lower A at 6.67 and 6.5 , respectively, and one batch of the first generation Surigao control stock had 6.33 . Slightly lower A estimates were noted in the first-generation selected stocks from Camarines (6.17 and 6.5) and Surigao (4.0). The expected heterozygosity estimates were not significantly different between the stocks and across generations based on the existing batches screened. Molecular marker data are being correlated with parameters for selected beneficial traits to determine if the markers could be used as preliminary indicators for genetic improvement.

For the tiger shrimp (*Penaeus monodon*), experiments to determine the differences and problems in breeding performance of male and female spawners from captive and wild environments, were conducted to understand the conditions that encourage and facilitate mating. Initial findings indicated that the wild and captive male shrimps appeared to pursue more frequently the wild female shrimps than the captive ones. The incorporation of vitamin C in the shrimp broodstock diet reduced the incidence of mortalities in domesticated shrimp broodstock. When young postlarval stages (for on-growing to potential broodstock size) were fed 2% taurine, mass weight was significantly higher compared to treatments with lower taurine levels. On their reproductive performance, tank-reared spawners matured until stage 2 but no stocks matured in the pens. Moreover, polychaete meal would be incorporated in the formulated broodstock diet for adult Indian prawn stocks to determine the effect of these diets on male sperm quality, female ovarian maturation and reproductive performance. The polychaete meal and the test diet are being analyzed further for their proximate composition and stability.

For the sandfish (*Holothuria scabra*), appropriate diet to improve breeding performance and larval quality in sandfish, is being developed. The basic biological composition (protein, lipids, fatty acids, etc.) of wild and hatchery-produced sandfish were determined. Using the proximate composition of wild-caught mature sandfish as reference, the practical diet is being developed to ensure that the nutritional requirements for enhancing breeding performance in adult sandfish are met. Preliminary feedings suggest that sandfish would require only low dietary levels of both protein and lipid, and that high lipid content appears to impede their growth.



Maturation diets are being refined to improve reproductive performance of sandfish

In the development of technologies for aquaculture of giant grouper, broodstocks had been collected from local sources and kept at the Igang Marine Station for regular monitoring of gonadal maturity. Molecular characterization of the stocks and induced spawning trials had been started. Hybridization has been tried at AQD by crossing a female giant grouper with male tiger grouper.

The effectiveness of biofloc as starter feed and settlement substrate for early stage polychaete (*Marphysa mossambica*) is being analyzed. Critical stages during early development, optimum stocking density and sediment depth required during their nursery and grow-out phases, and the effect of light exposure on the growth and survival in the grow-out phase, are being established. Egg hatchability and larval development of *M. mossambica* subjected to varying irradiance and photoperiod treatments are also being investigated.



Polychaete Marphysa mossambica: 4 days after hatching (left) and adult (right)

Refinement of hatchery and nursery protocols

Enhancements to laboratory and field-scale production of natural food organisms and alternative food items which serve as early stage diets were evaluated by AQD to increase production of the larval and juvenile stages of important aquaculture species. Improvements on rearing conditions and interventions to enhance survival of aquatic organisms during larval development were also carried out.

For the abalone, the effectiveness of using chemical cues (positive ions, algal extracts) to improve settlement rate and increase production of juveniles through improved culture techniques has been established by AQD. Efficient sorting and harvesting protocols using muscle relaxant were developed to improve the survival rate of abalone juveniles. For the effectiveness of algal cues as settlement inducer, the presence of agar-bound microparticulate diet and ammonium chloride (NH₄Cl) on top of the diatom *Nitzschia* sp., resulted in consistently higher settlement rates in transparent tanks of 12.06% and 2.83% after 5 and 10 days, respectively, compared to only *Nitzschia* sp., which produced settlement rates of 5.11% and 1.95%, respectively. When the potential chemical cues (NH₄Cl, GABA and serotonin) for abalone settlement were tried in bigger tanks, *i.e.* in 1.5-ton fiberglass tanks using NH₄Cl in combination with *Arthrospira platensis* and *Nitzschia* sp., highest settlement rate of 4.49% was attained after 5 days, while settlement after 10 days was 1.95%.

For the blue swimming crab (*Portunus pelagicus*), a formalin stress test has been promoted in hatcheries to ensure that only good quality larvae are used for further rearing. Results in hatchery and nursery-rearing of the blue swimming crab, indicated that crab instar 1-2 could tolerate salinities of 16-32 ppt, and about 8-20 ppt for the later stages (crab instar 3) but higher survival was achieved at 16-32 ppt. Crab molting intervals and increments were similar in all salinities from 16 to 32 ppt. The optimal stocking density for nursery rearing of the blue swimming in hapas within pens was then established at 10-15 individuals/m².

For the hatchery rearing of mangrove crab seedstock, the use of algal paste in rotifer culture was evaluated. *Nanochlorum* paste was used in rotifer culture but *Tetraselmis* paste proved to be a better option. Therefore, in order to improve the growth and density of rotifer, the protocol for the use of *Tetraselmis* paste will be established and compared with the *Nanochlorum* batch culture.

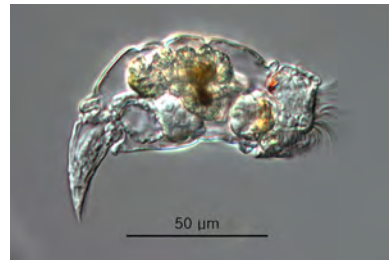
Pompano (*Trachinotus blochii*) are opportunistic feeders and can readily feed on wild zooplanktons present in ponds or in fish cages in marine waters. As means of attracting wild zooplanktons as supplemental food in the culture of pompano, the possibility of using artificial lighting in the nursery net cages was explored to reduce the costs of feeding caged pompano with formulated diets especially during its early stages.



Experimental setup on the use of artificial illumination in the floating cage culture of pompano

For the growth and survival of sandfish juveniles up to 20 g fingerling size, rearing was divided into two nursery phases: primary nursery phase for early juveniles (5 mm > fish > 40 mm or 3 g) and secondary nursery phase for late juveniles (3 g = fish > 20 g). The use of shaded and open hapa-in-tank nurseries was compared in rearing the sandfish, and the results showed that growth of sandfish juveniles in shaded tanks was twice greater than those in open tanks during the first month but on the second month, sandfish in the open tanks grew faster.

The potential of using locally-available microalgal strains as food for the minute rotifer, *Proales similis* de Beauchamp, was evaluated while the biochemical, proximate and cost of producing *Chlorella sorokiniana* microalgae was determined. Semi-batch culture trials showed lower cost of *C. sorokiniana* paste production. Also, *P. similis* could tolerate high salinity (30 ppt) but better results could be obtained if acclimatization is done prior feeding with the algae.



Minute rotifer (Proales similis) used as food for fish larvae

For milkfish (*Chanos chanos*), a protocol for transporting juveniles (average total length of 5-6 inches) from the nursery to sea cage facilities was developed, and the optimal temperature and salinity requirements for their transport had been defined. Preliminary findings showed that survival of milkfish juveniles a week after being transported for 4 to 6 hours at 25°C regardless of salinity levels (0 to 20 ppt) attained high survival (94-100%), while transporting milkfish juveniles at 25°C in higher salinities resulted in good survival. Prolonging the transport time to 12 hours did not have any adverse effect on the juveniles.



Size of milkfish juveniles used in the transport experiment

Promotion of technically and economically-viable breeding and seed production schemes

The breeding and seedstock production methods developed at AQD were verified on farm to ensure that these are cost-effective. Nile tilapia (*Oreochromis niloticus*) and giant freshwater prawn (*Macrobrachium rosenbergii*) seeds were produced at AQD's Binangonan Freshwater Station (BFS), to verify and demonstrate the methods for urban agri-aquaculture (aquaponics), and the latter to serve the needs of small-scale prawn farmers in the vicinity. Despite the small-scale production, the total tilapia produced from seed production tanks in March to December was about 111,284 pcs of fry and 70,744 pcs of A-net size seedstock. On the other hand, 53,970 fry and 29,145 A-net size seedstock were obtained from the tank meant for producing potential broodstock. All the seedstock produced were stocked in cages for on-growing to fingerlings or juveniles.

For the giant freshwater prawn, broodstock on-grown from juveniles obtained from the BFS hatchery-bred stock, were placed in 12 units of spawning tanks. Results showed that postlarvae (PL) production from January to August 2017 was recorded at 248,094 pcs with 54.11% survival to PL and mean number of days of metamorphosis to PL at 43. In April, breeder performance was poor with no PLs produced. Potential spawners were thus obtained from Isabela Province in September and stocked for spawning. In October, PL production totaled 33,771 with 65% survival to PL, while November data recorded production of 26,427 PL but still awaiting metamorphosis to PL and in December production data recorded 101,840 hatchlings and awaiting metamorphosis to PL.

To verify, demonstrate and promote prawn- and/or tilapia-based urban agri-aquaculture technologies, two portable aquaponic systems were constructed at BFS. In the first set-up, water morning glory or “kangkong” (*Ipomea aquatica*) seedlings were transplanted to the aquaponic substrates (1 cocopeat:1 carbonized rice hull:1 fine sand:1 plain rice hull). Giant freshwater prawns (12 pcs, ave wt: 10.74 g) and red tilapias (40 pcs, ave wt: 34.8 g) were stocked separately in the tanks where the red tilapias were fed daily with fish pellets. For the second set up, Chinese white cabbage or “pechay” (*Brassica rapa*) were planted in the



Portable aquaponics setup to explore the possibility of promoting the technology as a livelihood opportunity

pots while tilapias were stocked in a blue drum that serves as fish holding tank. Training on aquaponic systems would be organized soon.

1.7.2 Healthy and Wholesome Aquaculture

AQD has been promoting healthy and wholesome aquaculture, through the development of sustainable aquaculture feed with less dependence on fishmeal and fish oil, and advancement of aquatic health management. Reduction of the fish oil and fishmeal components in aquaculture feeds, without compromising the growth and performance of the cultured species, remains an international research priority. While alternative sources of fish oil and fishmeal are being sought by AQD, innovations on fish health management were carried out considering the devastating losses encountered by aquafarmers due to various aquatic diseases, and the need to preserve the environmental quality of aquaculture sites. New schemes, such as the use of probiotics and use of safer alternatives to drugs and chemicals, were therefore established.

Developing effective alternative protein sources to fishmeal and fish oil in dietary formulations

Copra meal (about 21% crude protein) could serve as valuable replacement for fishmeal by increasing the level of its protein. Protein-enhanced copra meal (PECM) is a potential alternative protein source in diets of high value species such as grouper *Epinephelus coioides*, after analyzing its nutrient profile and including it in different levels in grouper diet. Thus, AQD has been assessing the optimum inclusion level of PECM, its nutrient digestibility, and its effect on the liver and distal intestine morphology of groupers. Furthermore, protein-rich milkfish by-product has high potential as a feed ingredient, and processing this into a hydrolysate using an enzyme could improve its utilization. Milkfish by-product hydrolysate was evaluated as a feed ingredient in the diet of tilapia, *Oreochromis niloticus*. Confirmatory tests are ongoing due to low survival rates.

Lipid source is an important component in the formulated diet of abalone (*Haliotis asinina*) breeders. The algae thraustochytrid, has a good profile of fatty acids and could be a good alternative source for fish oil. The optimum amount of thraustochytrid in the abalone breeder diet has already been determined. However, since the amount of crude fat in the mass-produced thraustochytrid was low (1.8-2.8%), isolates were therefore prepared in petri dishes to increase the crude fat content of the algae to 20%.

Promoting practices and strategies in nutrition that improve production

Post-larvae of *Penaeus indicus* were produced in the hatchery and stocked for grow-out culture. Initial results showed better performance in shrimp fed a commercial diet low in crude protein content (40%). Male with sperm and mated female were noticeable during harvest and could be sources of breeders. Collaboration was forged with a farmer to use his pond for the grow-out culture of hatchery-bred *P. indicus* where all inputs would be documented to determine the profitability of *P. indicus* semi-intensive pond culture.



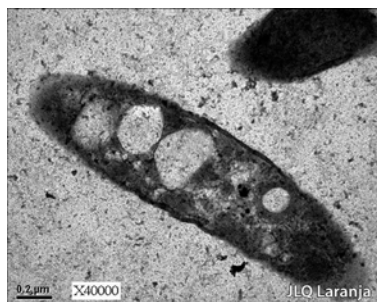
Penaeus indicus post-larvae produced from domesticated broodstock (left) and stocking of *P. indicus* PL 15 (right)

Testing the efficacy of indigenous probiotics

The use of bacteriophages, vaccines, probiotics, prebiotics, and recently the application of poly- β -hydroxybutyrate (PHB) and quorum sensing disruption have been developed and tested as means of minimizing or limiting the use of antibiotics in aquaculture. The protective effect of *Bacillus* sp. JL47 containing different levels of amorphous PHB was examined using the gnotobiotic *Artemia*. Isolate of *Bacillus* sp. was grown to accumulate different levels of amorphous PHB (29% and 55% PHB on cell dry weight) and fed to gnotobiotic *Artemia* nauplii during a *Vibrio campbellii* LMG 21363 challenge test.

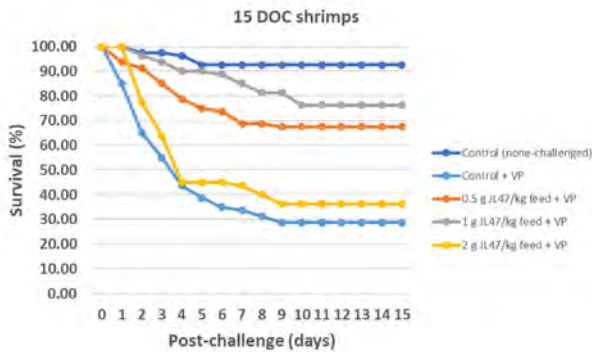
Results showed that *Artemia* nauplii fed the *Bacillus* sp. JL47 containing 55% PHB attained a significantly higher survival than those *Artemia* fed the *Bacillus* sp. JL47 containing 29% PHB. Complete protection against the pathogenic *V. campbellii* was observed in *Artemia* fed the *Bacillus* sp. JL47 containing 55%

PHB. The data suggest that, the protective effects of *Bacillus* sp. JL47 is superior when it contains higher amount of amorphous PHB and that the amorphous PHB is suggested to be a main determinant in the protective effect of the *Bacillus* sp. JL47.



Transmission electron micrograph (TEM) of probiotic *Bacillus* sp. JL47 strain containing the intracellular amorphous PHB

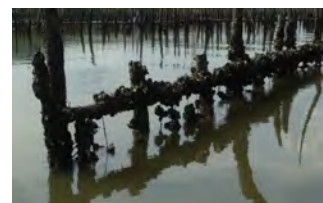
When *P. monodon* was challenged with *V. parahaemolyticus* 1213 strain, survival was highest (76.25%) in shrimps fed formulated diet supplemented with 1 g *Bacillus* sp. JL47 per kg, followed by shrimps fed the 0.5 g/kg (67.5%). Shrimps fed the formulated diet containing 2 g/kg attained survival of 36.25% while the lowest survival was observed in shrimps fed the control diet (without *Bacillus* sp. JL47 supplementation; 28.75%). The non-challenged shrimps (control) attained a survival of 92.5%. This suggests that the addition of amorphous PHB-accumulating *Bacillus* sp. JL47 can protect the shrimp against AHPND caused by *V. parahaemolyticus* 1213 strain. The suggested dose of supplementing *Bacillus* sp. JL47 in the feed is at 0.5-1.0 g bacterial weight per kg feed.



Survival of shrimps after a *V. parahaemolyticus* 1213 (VP) challenge, where prior to the challenge, shrimps were fed with a shrimp diet supplemented with different levels of *Bacillus* sp. JL47 for 15 days

Rationalizing the need and application of diagnostics that ensure biosecurity within culture systems

The Province of Capiz in central Philippines is one of the major producers of oysters in the country. AQD determined the microbial quality of oysters (*Crassostrea iredalei*) grown in Capiz Province by investigating the major oyster production sites located along the coastal villages of Roxas City, Ivisan and Pan-ay for fecal coliform, *Escherichia coli*, *Vibrio parahaemolyticus*, and presence of *V. cholerae* and *Salmonella* in the rearing water and oysters' meat, respectively. The results indicated that the monthly coliform count in the water samples collected from all sampling stations were generally high (≤ 540 MPN/100 ml) regardless of the sampling period (wet or dry season). Similarly, the monthly *E. coli* count in oysters' meat and intervalvular fluid were typically high (330~24,000 MPN/100 g) particularly during the warm dry months of the year. *V. parahaemolyticus* count quantified in oysters' meat samples examined was <3.0 MPN/g which is within the acceptable limit set by the Singapore Guideline (<100 MPN/g). Results for cadmium, chromium, lead, and mercury were below (nil) the limit of detection for all sampling sites. *V. cholerae* was not detected in any of the oyster samples examined.



Stake method: traditional method of culturing oysters in Cabugao, Ivisan, Capiz (left); traditionally cultured oysters in Agojo River, Pan-ay, Capiz (right-above); one of the rafts used for the relaying experiments in Cabugao Bay, Ivisan, Capiz (right-below)

All the oyster culture sites examined belong to Class C category of the EU Shellfish Area Harvesting Classification, indicating that oysters harvested from these areas are still safe for human consumption provided that they undergo proper relaying and depuration procedures or subjected to an approved method of cooking. Relaying oysters in an approved area in Cabugao Bay, Ivisan was attempted, and the results indicated significant drop in *E. coli* count in contaminated oysters from 24,000 MPN/100g to ≤ 20 MPN/ 100g after 2 weeks of relaying, suggesting the practicality of this technique in rendering raw oysters safe for human consumption.

Preventing and mitigating incidence of diseases in cultured mangrove crabs

The indicators responsible for disease occurrence or outbreak in cultured shrimps have been investigated considering that vibriosis and white spot syndrome virus (WSSV) have also persistently caused mortalities in mangrove crabs, *i.e.* vibriosis in the hatchery phase and WSSV in the grow-out phase. In shrimp culture, the mortality due to WSSV infection could be due to the viral load and environmental conditions such as low water temperature, while WSSV could be present in pond soil and water that serve as vehicle for infection. To address these concerns, the threshold levels for WSSV in the water, soil, and system in mangrove crab culture that could result in infection and mortality or outbreak were examined *in vitro* and *in vivo*.

1.7.3 Maintaining Environmental Integrity through Responsible Aquaculture

AQD has been developing environment-friendly aquaculture technologies to address issues on the impacts of aquaculture on biodiversity as well as on water and sediment quality in marine and freshwater systems, which have been promoted in the region. These include the Integrated Multi-Trophic Aquaculture (IMTA), where suitable extractive species are identified for reducing the organic and nutrient loadings from aquaculture, while threatened species with potentials for breeding, culture and eventual restocking had been identified to replenish the natural stocks. Farming protocols were therefore investigated for several aquatic commodities, *i.e.* refining existing oyster grow-out techniques; promoting the grow-out culture of abalone; and conducting culture trials for sandfish in ponds and sea ranch.

Oysters are filter feeders and do not need artificial feeding, and are grown in farms with a relatively low impact on the environment. For grow-out culture of oyster *Crassostrea iredalei*, AQD has established that grow-out in a brackishwater environment is best compared to sites which are mostly freshwater or mostly marine, as this environment allowed for the best growths and survival rates. Meanwhile, wild oyster spats grew significantly larger (87.1 mm shell length) than the hatchery-bred spats (81.3 mm).

Abalone, which grazes on marine algae and seaweeds, could be grown with hardly any negative effect on the environment. AQD has established the efficient culture system for the abalone (*Haliotis asinina*), indicating that abalone could be best cultured in PVC pipe shelters, whether in a tank or in a reef flat. In both culture environments, abalone performed best at a stocking density of 200 pcs/m².



Abalone in a PVC pipe shelter achieves the best growth

Culture of the giant freshwater prawn

Biofloc Technology (BFT), an environment-friendly and efficient system to produce aquaculture products since nutrients could continuously be recycled and reused, was evaluated for suitability to culture the giant freshwater prawn (*Macrobrachium rosenbergii*) across three stocking densities of 30, 40 and 60 prawns per 1-ton tank. After 6 months of culture, no significant differences in weight and growth rates was observed among the three stocking densities tested. However, survival was highest at the lowest stocking density and lowest at the highest stocking density. FCR was poor (3.23) and lowest at 60 prawns/m², but there was no statistically significant difference in FCR between the 30 and 40 prawns/m² treatments at 2.03 and 2.15, respectively.



Biofloc setup at AQD's Binangonan Freshwater Station for culture of giant freshwater prawn in 1-ton fiberglass tanks

The multiphase strategy for the grow-out culture of giant freshwater prawn was evaluated if it could significantly improve production in a cage culture system. At the second month, significant difference in mean weight of prawns was already apparent with bigger prawns in the lowest stocking density. The inverse relationship between weight and stocking density was observed up to the fourth month with no significant difference in the survival of the prawns.

Kappaphycus alvarezii farming

To demonstrate the technology of producing the seaweed *Kappaphycus alvarezii*, a two-day on-site training for seaweed farmers from Batbatan Island, Culasi, Antique Province, Philippines was conducted with participants who comprised 30 seaweed farmers. Topics on grow-out culture, common diseases, and updates on *Kappaphycus* culture were discussed in lectures and in an open forum. During the on-site visit to Batbatan Island, the trainees planted 200 pcs of seaweed plantlets at Sitio Bunlao on two 10-m culture lines while water parameters were continued to be monitored.



Onsite visit of trainees on seaweed farming to Batbatan Island in Antique Province, central Philippines

1.7.4 Adapting to Climate Change Impacts on Aquaculture

The changing global climate manifests its threats with more frequent and more intense extreme weather events experienced in recent years. Abnormal weather patterns or disturbances like extended hot and dry spells or intense drought and frequent heavy rains have resulted in severe flooding, among others. These climate-related disturbances are projected to impact broadly across ecosystems increasing the pressure on all livelihoods and food supply chains, including the fisheries and aquaculture sectors. In particular, the sustainability of aquaculture will be further challenged since the effect of these climatic changes on farmed organisms is largely unknown. The different aquaculture systems, facilities, and support systems to aquaculture operations, as well as the fish farmers themselves will be affected. The small-scale fish farmers in the region that produce the great bulk of the aquaculture production are largely vulnerable. Mitigation and adaptive measures are therefore needed to address the threats to food and livelihood provision that may arise due to the changing climatic conditions observed globally.

AQD therefore attempted to identify the accompanying changes in the environment brought about by the changing climate that may affect the aquaculture sub-sector. This is meant to prepare the sub-sector for the possible effects that these changes may have on aquaculture operations, minimize and mitigate the adverse impacts of climate change on aquaculture, and ensure the continued operation of all aquaculture production systems under changing climatic conditions. This is also meant to ensure that aquaculture production of important aquaculture commodities will continue even under conditions of higher temperature and more acidic waters for continuous supply of food fish and sustainable generation of income for the people.

Increased sea surface temperatures are expected to affect reproduction that could lead to the reproductive failure of some aquatic species. Observations in the mangrove crab (*Scylla serrata*) hatchery of AQD suggest that broodstock have failed to spawn during seasons of elevated temperature. As for the larvae, the Z1 stage was

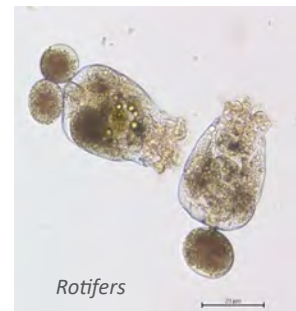


Mangrove crab spawner with eggs that failed to develop

observed to achieve the highest survival at 31°C. Meanwhile, older larval stages (Z2 to Z5) achieve better survival in ambient temperature (28-29°C) and have the lowest survival when reared at 33°C. Overall, the observations suggest that Z1 is more tolerant to elevated temperatures while Z3 and Z4 are more sensitive to higher temperatures.

This phenomenon correlates with previous findings on the siganid (*Siganus guttatus*) wherein reduced spawning was observed and hatching did not occur at an elevated temperature (33°C) and was very low under a diurnal temperature variation (31-33°C). Disrupted reproduction and decreased maturation rates were also observed earlier among captive shrimps and abalone (*Haliotis asinina*). Female abalone breeders died after 45 days at 33°C while only 10% of the males survived until day 60, and gonads of the said breeders also regressed. Meanwhile, 50% of abalone breeders survived at 31°C and ambient temperature resulted in 80% survival.

Along with increasing sea surface temperatures, climate change is also expected to lead to ocean acidification because of the increased concentration of carbon dioxide in the atmosphere. Noting that the average ocean pH is now at 8.1, rotifer production in AQD appears to be affected by a lower pH. Rotifer population growth was significantly higher at 33°C and 20 ppt (day 6 of culture = 367-396 ind/ml), and lower at pH 7.5. The size of rotifers was not significantly different among treatments (87-200µm) and no abnormality in swimming or morphology was observed in all treatments.



The same observations were made for the copepod *Pseudodiaptomus annandalei* where survival was lower in low pH (7.5) and high salinity (38 ppt). In another copepod, *Acartia tsuensis*, survival was likewise low in low salinity (20 ppt) and low pH (7.5).

AQD provided assistance to farmers for the conduct of the study “Economic benefits and losses of seaweed farmers in Guimaras, Philippines” due to some climate change indicators. The small-scale seaweed farming in Barangay Panobolon, Nueva Valencia in Guimaras Province was affected by lack of planting materials and diseases. High daily temperature variation recorded in January 2017 (10.1°C) coincided with the occurrence of the ice-ice disease and slow growth reported by seaweed farmers. The study will complete the time-series data on climate change-related indicators such as temperature, salinity, seaweeds harvest and monitoring diseases with the cooperation of local farmers in the fishing village.



Seaweed Diseases: Prevalence of ice-ice disease (left) and epiphytes (right) are seen whole-year, and its emergence are uncontrollable during summer season from March to May

Thus, all training courses offered by AQD have included a lecture on the impacts of climate change on aquaculture and strategies towards resiliency. AQD also supported and participated in the series of workshops on Climate Resilient Aquaculture Operations organized by the Bureau of Fisheries and Aquatic Resources and the FAO Regional Consultation on Climate Resilient Fisheries and Aquaculture in the Asia-Pacific Region in November 2017. AQD also provided expertise during a National Review and Calibration of Climate Change R&D Program of the Philippine Government in September 2017.



FAO/APFIC Regional Consultation on Building Climate Resilient Fisheries and Aquaculture in the Asia-Pacific Region

1.7.5 Meeting Social and Economic Challenges in Aquaculture

Recognizing the need to secure food and income, AQD developed and implemented social and economic strategies in aquaculture and resource management, to overcome the unintended socioeconomic problems brought about by the development of aquaculture. Approaches to this end include conducting socioeconomic studies that promote collaboration with stakeholders and the local government through community-based strategies, training of fisherfolks to ensure sustainable implementation of aquaculture projects, and creation of socioeconomic benefits for marginalized fishery stakeholders. More recently, AQD raised the understanding of aquaculture stakeholders on climate change indicators that provide basis for recommending adaptation and mitigation strategies in aquaculture operations.

Collaborative R&D in aquaculture

Milkfish (*Chanos chanos*) is the most consumed fish and common protein source in the Philippines and the mariculture of milkfish is the way to go to meet fish food requirements in the Philippines and other Southeast Asian countries. To address emerging nutrification problem in milkfish production areas around the Philippines, AQD conducted grow-out trials to evaluate the application of Integrated Multi-Trophic Aquaculture (IMTA) in milkfish culture.

Hatchery-reared milkfish seeds at stocking density ranging from 23-27 fingerlings per m² were stocked in two mariculture pens (156 m² average size) along with filter-feeding hatchery-reared sandfish (*Holothuria scabra*) juveniles and nutrient-absorbing seaweeds *Kappaphycus* sp. plantlets produced at AQD. Local fisherfolk members of the Pandaraonan Unified Association and the local government of Guimaras Province were involved in this activity. Results from four culture runs showed that production cost could be recovered, although constrained by high fingerling cost, feeds and other input shipment costs to the culture site and poaching. Also, sandfish and seaweeds in the IMTA system were not sustained due to predation and diseases.

Socioeconomic strategies were applied through value-adding options to overcome high input costs and to compensate for the lack of sandfish and seaweeds harvest. Overall, the collaborative R&D activities such as the application of IMTA in milkfish mariculture successfully improved the aquaculture skills of the fisherfolks by teaching them to grow economically important fish and seaweeds. The fisherfolks also learned entrepreneurial and postharvest skills by selling their milkfish harvest, training women in the community to debone and prepare milkfish dishes. Cooked milkfish in oil were fed to school children to encourage fish consumption to improve their nutritional condition. These IMTA social and environmental experiments are being co-funded and implemented together with research fellows from the Japan International Research Center for Agricultural Sciences (JIRCAS).



Workshop on Management of Community-Based Aquaculture Projects participated by fisherfolks, women and local government officials of Barangay Pandaraonan, Nueva Valencia, Guimaras



Value-adding of milkfish harvest from IMTA experiments was highly appreciated by women in Barangay Pandaraonan

Collaborative efforts were also sustained through two Community-Based Resource Enhancement (CBRE) activities that use hatchery-reared seeds for stock enhancement in depleted fisheries. The one that involves hatchery-reared abalone, (*Haliotis asinina*) and sandfish (*Holothuria scabra*) stocked at the Sagay Marine Reserve in Negros Occidental and funded by Government of Japan-Trust Fund (GOJ-TF), has demonstrated that hatchery-reared seeds released in suitable protected sites can help rebuild depleted coastal resources, supplement livelihood, and contribute to improving the supply of abalone in markets. Fisherfolk in Sagay benefited from the harvest of spill-over from the released abalone and sandfish in the CBRE site while the local government unit and fisherfolk associations continued to manage the project.



AQD participated in the Sustainable Seafood Week held in Manila to promote the sourcing of seafood from sustainable fisheries and aquaculture



Hatchery-reared sandfish from the CBRE project grew to marketable size in sea ranch area in Molocaboc in Sagay

Moreover, AQD participated in the *Sustainable Seafood Week* campaign of high-end gourmet establishments that aims to improve the health of the oceans by sourcing seafood products from more sustainable fisheries and aquaculture. Through such event, the awareness of stakeholders had been raised, especially on the significance of the CBRE activities implemented by AQD.

The other CBRE of hatchery-reared tiger shrimp *Penaeus monodon* in New Washington Estuary (NWE) in Aklan province was funded by Research Institute for Humanity and Nature (RIHN) of Japan. Released tiger shrimp juveniles grew to >100-g marketable size as monitored in fish buying stations in the fishing community. However, implementation of existing fishing gear regulations should be addressed together with local government and fisherfolks as fine mesh nets entrapped the released tiger shrimp juveniles. These indicate the need for improving governance to support stock enhancement and ensure economic benefits for the fisheries stakeholders.

Multi-agency collaboration and sharing of information

AQD established collaboration and linkages with the local government units and fisherfolk associations in areas where studies on IMTA and CBRE are being conducted. The tri-party collaboration between organized fisherfolk, the local government and AQD successfully



AQD staff with local fisherfolk of Molocaboc Diut, comprising the inhabited island within the Sagay Marine Reserve in the Philippines, released hatchery-reared juveniles in the CBRE replicate site which local fisherfolk will protect and monitor

demonstrated, promoted and achieved social and economic objectives for the IMTA in Guimaras and CBRE project sites in Negros Occidental and Aklan Provinces. Multi-agency collaboration initiated the replication of CBRE in more sites in Sagay and other potential remote coastal communities in Camarines Sur Province through a local state university.



CBRE seminar conducted in Partido State University in Goa, Camarines Sur and site assessment of potential replicate site in Barangay Haponan in Caramoan, Camarines Sur

1.7.6 Environment-friendly, Sustainable Utilization and Management of Fisheries and Aquaculture Resources

The expansion of the tilapia industry has intensified the demand for fishmeal as one of the primary protein sources in aquaculture feeds. Due to increasing costs of fishmeal, various fishmeal replacers for tilapia, including agro-industrial wastes and by-products, were explored by AQD and information on their nutritive value and inclusion level tested to ease dependence on fishmeal. Mango peel silage, soybean curd residues and citrus by-products were evaluated for their potential as fishmeal substitute.

Substitution of fishmeal with mango peel silage up to 500 g/kg diet increased fry production but resulted in slightly reduced weight gain of tilapia breeders over the 51-week period. Soybean curd residues could replace up to 300 g/kg diet of fishmeal protein in tilapia fingerlings diets. Supplementation of citrus by-products such as citrus peel and citrus pulp at 10 g/kg diet also enhanced growth and feed utilization of tilapia fingerlings.

As diseases continue to devastate the shrimp industry, one culture system that has the potential to abate disease occurrence and improve shrimp survival is aquasilviculture – the culture of aquatic organism with mangroves inside the pond (mixed system) or in the receiving environment. This study aims to determine the time required for a mangrove habitat to remove nutrients from shrimp farm effluents. Preliminary results showed that ammonia, phosphate, chlorophyll a and total suspended solids were fluctuating but generally lower in water drained into a mangrove habitat compared to an area without mangroves. Ammonia and phosphate were removed from the pond effluent drained into a mangrove habitat, 3-5 days after draining. Furthermore, mangrove to pond area ratio does not seem to affect efficiency of mangrove habitat in nutrient removal.

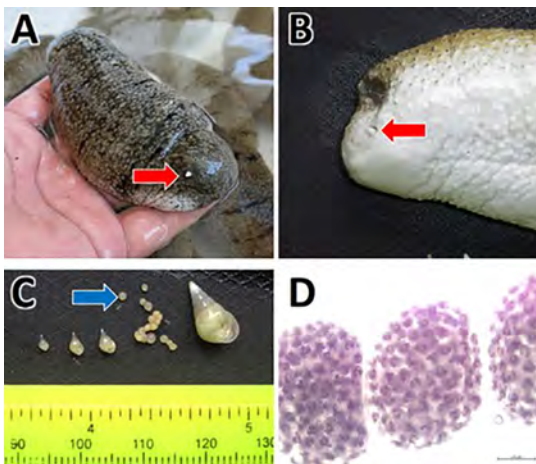
Promotion of community-based production and resource enhancement of high-value aquatic resources

Sandfish (*Holothuria scabra*) are detritus feeders in intertidal flats and reef areas that help aerate marine sediments and recycle nutrients necessary for maintaining marine ecosystems. Abalone (*Haliotis asinina*) are gastropods that feed on encrusting algae and micro-particulates in coralline areas. Households in coastal and island communities earn income from selling these high-value export commodities, however this has also led to the overexploitation of these species. The community-based integrated production of abalone and sandfish through culture, sea ranching and stock enhancement has been promoted for low-income households in Molocaboc Island within the Sagay Marine Reserve in Negros Occidental, Philippines. This was also aimed at maintaining the health of the intertidal and reef environment through production systems that use hatchery-bred seeds produced from local broodstock and grown with natural food while providing sustainable sources of income for coastal dwellers in remote island communities.



Children selling abalone spill-over (>7-10 cm shell length) gleaned by their parents in areas outside the CBRE release site

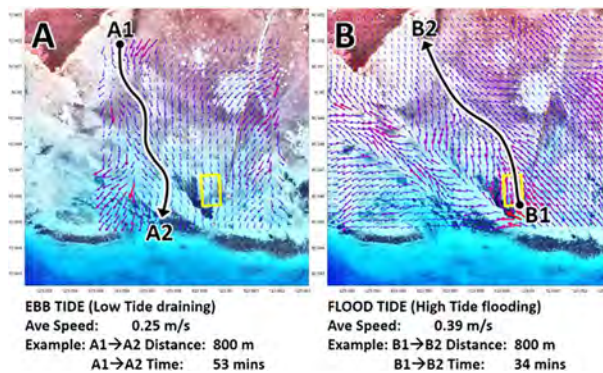
A total of 81,918 hatchery-reared sandfish juveniles were nursed in hapa nets, of which 19.9% were stocked in pens, and 10.6% were released in a sea ranch in Molocaboc Dacu from August 2015 to November 2017. The density of sandfish within the sea ranch has increased from less than 3 individuals/hectare in 2015 to 53-128 individuals/hectare in 2017, which indicate that sandfish sea ranching can be a helpful intervention to mitigate further loss of this commercial species.



The gastropod endo-parasite of sandfish found at Molocaboc, showing infection at the anal or posterior portion of the sandfish host (A & B), while common infection is composed of multiple individuals and numerous egg sacks (C) which encapsulates embryos (D)

New challenges arose as few legally marketable size sandfish (>300 g size) were observed to have gastropod endo-parasite infestations on March 2017. While this is being studied, all infected individuals were removed from the site beginning July 2017. Consequently, nursery rearing of early sandfish juveniles in floating hapas was stopped after March 2017, while rearing of late juveniles in pens was stopped in July 2017.

The tidal current was monitored to determine the water flow within and around the Molocaboc sea ranch site and to show potential dispersal direction of planktonic larvae of abalone and sandfish. Tidal current at the Molocaboc sea ranch site is generally low. The general direction of currents during flood tide will lead planktonic larvae of abalone and sandfish to thick covers of sea grasses which are known to be good settlement substrates particularly for sandfish larvae. Construction of a solar and fuel-powered abalone hatchery in Molocaboc Dacu began in December. This is expected to sustain a supply of juveniles for future releases.



Tidal water current profile at the Molocaboc sea ranch site (20 Sept 2017) during ebbing tide (A) and flooding tide (B), with small blue/red arrows point to the direction of tidal current, while arrow thickness and length are proportional to speed (red arrows are faster than blue), and the sandfish sea ranch site is indicated by the yellow rectangle



On-going construction of abalone hatchery on stilts alongside the foot walk connecting Molocaboc Dacu and Diut, Sagay Marine Reserve, Negros Occidental, Philippines

Seahorses (*Hippocampus* spp.) are highly exploited for their high price, but are among the first marine fishes of commercial importance to be listed in the International Union for Conservation of Nature (IUCN) and all seahorses are listed the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) Appendix II. AQD promoted the resource enhancement of seahorses primarily by developing appropriate release and monitoring strategies of seahorses and involving the community in the management of the natural resources. Transport trials on three size groups of juvenile seahorses (5, 6, and

7 cm stretched height) showed optimum stocking density of 3 ind/L for all size groups at 10 to 12 h transport duration.

Results of monitoring of seahorses in Molocaboc Island showed increase of natural stocks in 2016-2017 compared to previous years (2012-2015). This suggests that natural population of seahorse may recover through management of the natural resources, particularly by minimizing human disturbance on their habitat and non-collection of seahorses. Natural food such as mysids and copepods are abundant in the area, which explains the all year round presence of sexually mature seahorses. However, the average number of seahorses from 2017 (30 ind or 0.0025/m²) showed a much lower density than the reported (0.02/m²) low density of seahorse in Bohol Province. Nevertheless, releasing of hatchery-reared juveniles could enhance the recovery of the seahorse population and density.

Fisherfolk organization members participated in the hands-on training organized by AQD on monitoring of seahorses. Practical lectures on seahorse biology and handling of live seahorses were conducted for divers during seahorse sampling. The annual information, education and communication campaign this year was held on 22-23 November 2017 wherein lectures on seahorse biology and resource management was given to local stakeholders, particularly the elementary and secondary students of Molocaboc Island. A Draw and Tell contest was conducted with the theme “My role in the promotion of seahorse as a natural resource in my community.”



Students participating in the Draw and Tell Contest which highlights the importance of protecting the habitat of seahorses

Technology extension and demonstration

As the aquaculture of high-value marine finfish species continues to develop rapidly in Southeast Asia, a training program on “Marine Fish Hatchery” will extend and demonstrate the breeding, hatchery seed production, nutrition and health management of different marine fish species. Out of 7 total participants, 2 were supported by the Government of Japan Trust Fund (GOJ-TF), 1 each from Myanmar and Viet Nam. Training activities included lectures, slide and video showing, while practical activities covered larval rearing, natural food culture of both phyto and zooplankton, feeding, water management, fish health management, induced spawning, egg collection and harvesting and field visits. Trainees had hands-on larval rearing of all the marine fish species at the fish hatchery namely, milkfish, seabass, siganid, grouper, snapper and pompano.



Trainees preparing the larval rearing tanks by installing aeration lines



Trainees during pompano broodstock sampling



Practical training session on culture media preparation

The “International Training Course on Community-based Freshwater Aquaculture for Remote Areas of Southeast Asia” was conducted on 21-30 November 2017 at the Binangonan Freshwater Station to promote and transfer freshwater aquaculture technologies applicable to rural areas. Five of the 7 participants (1 from Cambodia, 1 from Myanmar and 3 from the Philippines) were supported by the GOJ-TF. Participants were trained in freshwater fish culture technologies and social preparation methods for rural aquaculture development.



Trainees learning to determine the sex of freshwater prawn broodstock (left), and injecting bighead carp broodstock (right) to induce spawning

1.7.7 Other Aquaculture R&D Activities

Agree-Build-Operate-Transfer (ABOT) Aquaculture Business (AquaNegosyo)

In sustaining its comprehensive technical assistance to new aquaculture entrepreneurs or those refocusing businesses, AQD continued to respond to inquiries and accept requests from the industry, from site assessment to design, construction, actual production runs, troubleshooting and post-production analysis. In 2017, a total of 22 clients were entertained, 5 of whom have progressed to site assessment. Most of the clients (42%) were interested in the culture of crabs. Techno forums were also organized for fish farmers and stakeholders at the Tigbauan Main Station, in the town of Aklan, and the cities of Davao and Pasay in the Philippines. Over 400 participated in the seminars and discussions which covered topics on multi-species marine fish hatchery, mangrove crab culture, soft-shell crab production, single oyster grow-out, freshwater aquaculture, tissue culture of seaweeds, aquatic health management and on-farm feed production.

Institutional Capacity Development for Sustainable Aquaculture (ICDSA)

For enhancing the technology transfer of aquaculture technologies developed by AQD, Training for Manpower Development on Shrimp and Marine Fish Aquaculture was planned to enhance the capacities of graduates of fisheries universities and colleges, particularly on shrimp and marine fish technologies. The training specifically aims to build a team of capable fisheries technicians and managers who can be fielded to the multi-species fish hatcheries around the Philippines in collaboration with the Philippine Bureau of Fisheries, Local Government Units (LGUs) and state universities. In partnership with LGUs, AQD provided training to fisherfolk in the provinces of Batangas, Iloilo and Oriental Mindoro. Beneficiaries of the trainings were communities affected by Typhoon Haiyan as well as fisherfolk organizations and cooperatives.



AQD scientists giving lectures on crab anatomy to locals affected by Typhoon Haiyan (left), and locals responsible for maintaining a mangrove sanctuary took part in the sponsored training on mangrove crab culture (right)

Training and Information

AQD continued to demonstrate its significant contributions to aquaculture development in the region by building institutional capacities and developing a critical mass of experts on aquaculture technologies. Eleven regular training courses were conducted while 18

specialized training courses were provided upon the request of stakeholders. A total of 29 training courses were held in 2017 and attended by 385 trainees.

Meanwhile, 44 individuals availed of AQD’s Internship Training to improve their proficiency and gain experience on their chosen areas of interest. Also, On-the-job Training (OJT) was availed by 307 students from 39 schools. OJT provides students with hands-on participation in AQD activities to satisfy their academic requirements and to give them practical knowledge and skills.

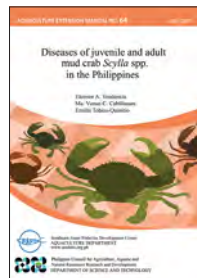


Practical session of the training on oyster seed production, nursery and grow-out

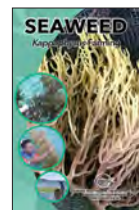


On-the-Job trainees at the abalone hatchery

In 2017, 49 articles were published by AQD researchers in technical and scientific journals, and proceedings. The aquaculture publications released by AQD include “Philippines: In the forefront of the mud crab industry development,” and Proceedings of the 1st National Mud Crab Congress held in 2015. Extension manual on “Diseases of juvenile and adult mud crab *Scylla* spp. in the Philippines” was also produced and disseminated. Six new brochures on the culture of different aquatic commodities was also produced including one on the



“Philippines: In the forefront of the mud crab industry development” (left), and “Diseases of juvenile and adult mud crab Scylla spp. in the Philippines” (right)



Various commodity brochures produced and distributed by AQD in 2017

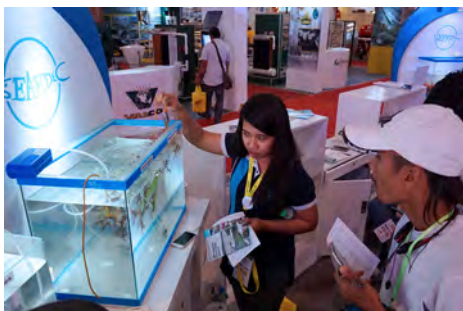
Brochure on AQD’s Community-based Resource Enhancement Project

production of abalone and sandfish in AQD’s Community-Based Resource Enhancement Project. “AQD Matters,” the Department’s newsletter continued to be published bi-monthly and circulated in-house and thru an email list.

AQD participated in 8 exhibitions and organized 1 to promote its sustainable aquaculture technologies and to distribute aquaculture books, manuals and brochures produced by AQD. Notably, AQD sponsored the “Agrilink 2017” the largest annual agribusiness exhibition in the Philippines visited by around 25,000 visitors, where AQD Scientists delivered technical seminars and provided consultation to fish farmers and the academe. Highlighted during the exhibition were technologies on soft shell crab production, grow-out of single oysters in pouches, use of seaweed plantlets from tissue culture, and aquaculture of abalone. Information dissemination through mass media was ramped up with 17 press statements delivered by AQD contributing to 54 appearances in print and online media as well as 2 television appearances.



AQD researchers providing aquaculture seminars for the public during exhibitions



Seaweed exhibit set-up attracting inquiries from visitors



AQD experts providing consultations to fish farmers

The official website (www.seafdec.org.ph) continued to be updated, improved, and integrated with social media to attract engagement. A total of 63,059 unique visitors were logged for the year with 345,060 page views. The SEAFDEC/AQD Institutional Repository (SAIR) also continued to enhance the accessibility of the Department's scholarly and research information by making them available for free and online. From January to December 2017, about 2,070,580 searches were performed at SAIR and 1,326,857 PDF files were downloaded.

FishWorld, AQD's visitor center and museum of aquatic biodiversity received 6,640 guests in 2017. Twenty-two students participated in the Internship and On-the-Job Training Program of FishWorld, coming from 4 different high schools. The celebration of the annual Aquaculture Week was participated by 6 high schools and 15 elementary schools from both public and private schools with about 116 students and 68 coaches participating in the various Science-Art Contests. FishWorld also works on the conservation of endangered megafauna. For 2017, 9 sea turtles were brought to FishWorld after being rescued from fish traps or found along the beach. Four of these turtles were released after tagging, 2 are under rehabilitation, while 3 died and were preserved.



Cloth art by secondary students participating in Sci-Art contests during the celebration of Aquaculture Week at AQD's FishWorld

Students and teachers during the Bring Show and Tell competition at FishWorld

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

2.1 Biotoxins Monitoring and Harmful Algal Blooms (HABs) in the ASEAN Region

Marine biotoxins represent a significant and expanding threat to human health, and their impact is 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 the death of marine animals and birds. As defined by the Codex Alimentarius Code of Practice for Fish and Fishery Products (CAC/RCP 52-2003), biotoxins are poisonous substances naturally present in fish and fishery products or accumulated by the animals feeding on toxin producing algae, or in the water containing toxins produced by such organisms. Although

monitoring seafood for toxicity is essential to manage the risks, there are several limitations in monitoring for toxicity such as the variation in toxin content between individual shellfish, different detection and even extraction methods for the various toxins, requiring a decision which toxins one is testing 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. Meanwhile, the growing harvest of non-traditional shellfish (such as moon snails, whelks, barnacles, and so on) could lead to increased human health problems and management responsibilities.

The SEAFDEC/MFRD Programmes through the Post-Harvest Technology Centre of the Agri-Food and Veterinary Authority of Singapore (PHTC/AVA), therefore implemented the project **“Chemical and Drug Residues in Fish and Fish Products in Southeast Asia - Biotoxins Monitoring and HABs in the ASEAN Region”** from 2009 to 2019 to expand and improve the initiatives in monitoring, detecting and sharing of information on marine biotoxins in order to reduce public health risks associated with consumption of contaminated shellfish and fish. During the project first phase, the activities covered training in analytical methods for Diarrhoeic 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 in 2012, the project was extended until 2017 to address the needs of Member Countries on capability building in biotoxins analyses and monitoring, giving focus on other biotoxins like the Amnesic Shellfish Poisoning (ASP) toxin (Domoic Acid) and Azaspiracids (AZA). Brevetoxin (BTX) which causes Neurotoxic Shellfish Poisoning (NSP) was also included in the new project, considering that ASP, AZA and BTX along with DSP and PSP, are regulated according to the CODEX for shellfish. During the End-of-Project Seminar in 2012 for the biotoxins monitoring project, the Member Countries also raised the need to address issues on Harmful Algal Bloom (HAB) because identifying the biotoxin-producing HAB species to complement existing biotoxins monitoring activities, is necessary to ensure that fish and shellfish are not contaminated with toxic algae or their toxins. Thus, from 2015, MFRD incorporated the new activities under this project to enhance regional capabilities for the identification of biotoxin-producing HAB species.

Nevertheless, during the project implementation in 2016, several Member Countries were challenged by inadequacy in manpower and technical resources to implement the biotoxin monitoring survey, resulting in the delay and extension of the survey until the end of 2017. As a matter of fact, when MFRD organized the “Regional Training Course on Identification of HAB Species in the ASEAN Region” in 2016, the countries expressed the need for more training sessions on specimen preservation and culturing techniques, as well as identification and monitoring of HAB species. The project was therefore extended for two more years (2018-2019) to incorporate these activities.

MFRD conducted on 10-13 July 2017, the “Regional Training Course on Specimen Preservation and its Application in HAB Monitoring and Studies” in Kelantan, Malaysia in collaboration with the Institute of Ocean & Earth Science (IOES) and the University of Malaya (UM). The training course included both lectures and practical sessions on HAB specimen preservation methods and techniques, use of fluorescence and electron microscopy, and flow cytometry. Attended by 22 participants from the 9 AMSs (except Myanmar), the training enhanced the participants’ knowledge and capabilities on HAB



Regional Training Course on Specimen Preservation and its Application in HAB Monitoring and Studies convened in 2017 in Kelantan, Malaysia

specimen preservation methods and techniques, and on the use of fluorescence and electron microscopy and, flow cytometry for HAB monitoring and studies.

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, and there has been an increasing demand for seafood as consumers around the world have recognized their nutritional value. However, seafood is very perishable and several chemical and biological changes occur immediately after capture and/or during 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 product fresh and safe, extend shelf life and maintain its quality and economic value from catch in fishing grounds or produce from fish farms to consumers.

Throughout the seafood supply chain, the seafood industry relies on proper cold chain to ensure the commercial viability of the seafood products. Modern technologies for seafood production at the aquaculture farms, seafood catch onboard 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. This cold chain may 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 processing, storage and transportation to effectively reduce the spoilage of fish.

The implementation of cold chain for seafood in the region involves a number of challenges. One of the major challenges is the 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 region are largely handled by small and medium-sized establishments which lack the appropriate facilities, technologies and knowledge in adopting cold chain practices. Lastly, cold chain management is still seen as non-mandatory in many countries; some cold chain guidelines may have been established but cannot be enforced as regulations. Notwithstanding these challenges, the Project **“Cold Chain Management for Seafood”** was therefore initiated and implemented by SEAFDEC/MFRD Programmes from 2015 to 2017 to create a platform for the ASEAN region to share knowledge, experiences and cost-effective technologies on the cold chain management for seafood. A set of general guidelines could be established to serve as a benchmark for the Member Countries when developing their own national guidelines. Nonetheless, it is imperative that cold chain management of seafood should be promoted to safeguard consumers’ health and food security, and to ensure the sustainability of the seafood industry.

To follow-up on seafood cold chain pilot trials implemented by participating AMSs in 2016, namely: Cambodia, Indonesia, Malaysia, Myanmar, Philippines Singapore, Thailand, and Viet Nam, MFRD convened the “Project Evaluation and Progress Meeting” in Singapore on 25-27 July 2017. The Meeting was attended by 21 participants from both government and private sectors of the AMSs. One of the expert trainers at the previous workshop on cold chain management for seafood held in 2015 participated in the Meeting to assist in facilitating the discussion on the draft Regional Guidelines on Cold Chain Management for Seafood. During the Meeting, the participating countries presented updates on the implementation status and progress of the pilot trials conducted in their respective countries, as well as discussed and evaluated the results of the pilot trials including the issues and challenges encountered during implementation and conduct of national activities. In addition, the Meeting also discussed and prepared the preliminary draft of the “Regional Guidelines on Cold Chain Management for Seafood” which was renamed at the Meeting as the “Regional Guidelines on Cold Chain Management for Fish and Fishery Products in the ASEAN Region.” Subsequent to the Meeting, MFRD proceeded with the preparation of the draft Regional Guidelines on Cold Chain Management for Fish and Fishery Products in the ASEAN Region,” which was circulated to the Member Countries for comments by their relevant competent authorities before finalization and endorsement during the End-of-Project Meeting in April 2018. The Guidelines will then be published for distribution to all AMSs for reference and



Evaluation and Progress Meeting for the Cold Chain Management Project

usage. It is expected that this project would help enhance the quality and economic value of seafood from the AMSs, contributing to economic development, and food safety and security in the future.

2.3 Reinforcement and optimization of fish health management and effective dissemination in the Southeast Asian Region Accelerating Awareness on Fish Health Management in Southeast Asia

Viral and bacterial diseases have caused major constraints in shrimp farming in most Asian countries and in the world. Early detection of these devastating pathogens is the most efficient response to be able to implement immediate and appropriate interventions for the control of the spread of infection. AQD determined the threshold infection levels (viral DNA/RNA copies in an organism that can result to an infection) for WSSV and *Vibrio parahaemolyticus* (VP_{AHPND}). Knowing these will enable the farmers to strictly monitor the health status of shrimp so that early and effective intervention strategies can be implemented. Also, the known threshold levels for the pathogens will serve as a reference in the regular monitoring and diagnostic schemes in the farm level, if it is still safe or dangerous.

Standard curve has been established using WSSV plasmid. Preliminary infection experiments to determine the concentration of viral inoculum that killed 50% of injected shrimp (LD₅₀) were conducted for the 3 weight ranges (3.81, 7.42 and 16.83 g) which showed that LD₅₀ at viral dilution of 10⁻⁶ were achieved faster in smaller weight range (9 days for ABW 3.81 g) compared to bigger weight range (10 days for ABW 7.42 g). LD₅₀ for ABW 16.83 g was achieved with lower viral dilution of 10⁻⁵ at 9 days. All the mortalities were found to be WSSV one-step positive.

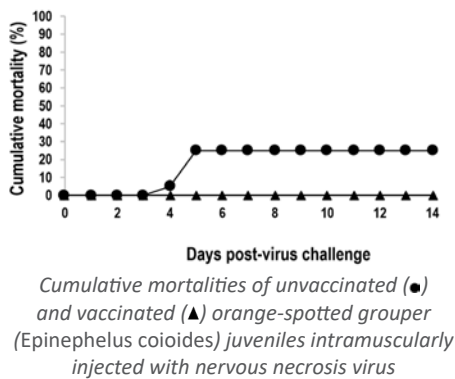
Time-course experiment was subsequently conducted. Mortality for ABW 3.81 g has started at the range of 1.6x10⁹ to 3.3x10⁹ copies/g, 195 h post infection (pi). The range for the survivors was from 3.3x10⁶ to 4.1x10⁶ copies/g, 231 h pi. Mortality for ABW 7.42 g has started at the range of 3.7x10⁹ to 5.1x10⁹ copies/g, 231 h pi. The range for the survivors was from 6.3x10⁶ to 8.9x10⁶ copies/g, 264 h pi. Mortality for ABW 16.83 g has started at the range of 1.2x10⁹ to 4.6x10⁹ copies/g, 162 h pi. The range for the survivors was from 6.8x10⁶ to 8.8x10⁶ copies/g, 219 h pi.

Enhancement of efficacy of vaccine treatment in tropical cultured species

Viral nervous necrosis (VNN) caused by nervous necrosis virus (NNV), a piscine betanodavirus, is a destructive disease that induces neuropathological abnormalities in maricultured fishes generally at the larval and juvenile stages. A study was carried out to develop and adopt methods that would enhance the efficacy of the present NNV vaccines through the use of immunoadjuvants and other substances that promote the activation of antiviral responses in marine fish. A practical method to deliver the vaccine to fish would be developed to prevent unwarranted outbreaks of VNN in hatcheries and grow-out culture systems.

AQD investigated the field efficacy of the inactivated NNV vaccine in orange-spotted grouper (*Epinephelus coioides*) reared in net-cages in earthen pond. Seroneutralization assay conducted on the sera of vaccinated fish revealed the presence of neutralizing antibody titers from day 30 to day 150 with the highest titer observed at day 60 post-vaccination. Nil and 25% mortality were obtained in both vaccinated and unvaccinated fish, respectively, when challenged with NNV through intramuscular injection. Additionally, NNV-challenge of day 120 vaccinated and control fish likewise resulted in nil mortality, suggesting an age or weight dependent susceptibility to NNV.

Taken together, the data suggests that single vaccination with inactivated NNV vaccine could mount and confer respectively the production of protective antibodies and concomitant protection against VNN in groupers especially during the early phase of grow-out culture in earthen ponds when these fish species are highly susceptible to the disease.



Grouper affected by viral nervous necrosis (VNN)

Application of adjuvants, carriers and RNAi technology to enhance the antiviral immune response of shrimp to WSSV

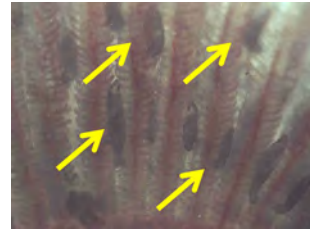
In shrimp aquaculture, a safe, effective, and inexpensive antiviral treatment is required to limit the impact of WSSV and other shrimp viruses. RNAi is a new technology that is based on gene silencing. The antiviral effect of RNAi is based on silencing a viral or host gene that is primarily involved in viral pathogenesis. The main constraint of RNAi as an antiviral agent is production cost and a practical method of delivery. Thus, dsRNA was produced using a low-cost bacterially expressed dsRNA production method. The efficacy of dsRNA was tested in several challenge experiments using various dsRNA doses, different frequency of dsRNA administration, and inclusion of heterologous dsRNA to test the specificity of gene silencing.

The best treatment was determined to be a dose of 20 µg/shrimp administered 4 times over 28 days (2 times before and 2 times after challenge (total = 80 µg/shrimp)). Furthermore, the silencing was found to be specific to VP28 dsRNA. Oral delivery using different ratios of dsRNA to rVP28 entrapped in microparticle carriers will be tested by challenge experiments in tanks.

Establishment of protective measures against persistent and emerging parasitic diseases of tropical fish

Results of the study that aims to develop practical strategies could be adopted by farmers to address the pressing problem on mass mortalities of net-caged and pond-reared fishes attributed to persistent and emerging fish parasites. This study examines the anti-parasitic effect of garlic (*Allium sativum*) in the form of allicin powder against monogenean parasites (*Pseudorhabdosynochus lantauensis*) infecting groupers (*Epinephelus coioides*).

Acute toxicity bioassays to determine the 96 h LC₅₀ value of allicin powder were carried out in static systems. Results showed that the median lethal concentration (LC₅₀) of allicin powder to grouper for 24, 48, 72 and 96 h of exposure are 172.37, 168.52, 134.90 and 73.63 ppm respectively. Oral treatments using allicin powder-supplemented diet (0.10%, 0.50%, and 1.0%) and a control diet without allicin were tested on groupers infected with gill monogenean *P. lantauensis* for 14 days. Results showed that groupers fed with allicin powder supplemented diets showed reduced prevalence and mean intensity of monogenean parasites as compared to the control. Histological examination showed no pathological changes in the liver, intestine and kidneys of the fish.



Parasites (Pseudorhabdosynochus lantauensis) in the gills of grouper

Also, hematological changes were compared in both *Trichodina* sp.-infected and uninfected tilapia (*Oreochromis niloticus*). Results showed that hematocrit, hemoglobin and red blood cell count were lower in infected fish than in healthy individuals. In contrast, white blood cell count was higher in infected fish compared to non-infected fish.

Acute toxicity bioassays to determine the 96 h LC₅₀ value of allicin powder in tilapia (*Oreochromis niloticus*) were carried out in static systems. The LC₅₀ values of garlic extract for 24, 48, 72 and 96 hours were 398.1, 360.7, 316.21 and 208.95 ppm respectively.

Epidemiology of the Early Mortality Syndrome (EMS)/ Acute Hepatopancreatic Necrosis Disease (AHPND)

Early Mortality Syndrome (EMS) or Acute Hepatopancreatic Necrosis Disease (AHPND) is a shrimp disease caused by the *Vibrio parahaemolyticus* affecting most Southeast Asian Countries. This activity aims to develop protective measures, in cooperation with farmers and hatchery operators, based on the causative agents together with identification of risk and protective factors. Results of the pathogenicity tests indicate that the threshold level of VP_{AHPND} bacteria in the environment that shrimp may overcome is 10⁶ cfu/ml.



Shrimp on top infected with AHPND shows an empty stomach, pale hepatopancreas, and empty midgut

Furthermore, exposure to 10^7 cfu/ml VP_{AHPND} bacteria may cause significant mortality in *P. monodon* postlarvae. High temperature (35°C), high (28 ppt) and low (10 ppt) salinities are other possible factors that may increase the risk of mortality due to VP_{AHPND} infection.

Use of greenwater that has been stocked with siganid (*Siganus* spp.) for not less than 2 weeks might provide some protection against the disease as shown by less *V. parahaemolyticus* detected in the hepatopancreas of shrimp. Use of siganid water to culture shrimp was further shown to improve shrimp growth and survival. Use of brown mussel (*Perna perna*) may also improve shrimp survival but needs further investigation.

Technology extension and demonstration

On-site evaluation of the aquaculture practices in selected developing countries was conducted to assess the compounding factors that trigger persistent diseases caused by parasites, bacteria and viruses in freshwater fishes. To boost the capability of fish health personnel, basic on-site training courses on fish bacteriology and parasitology were also organized, e.g. the on-site training course on “Health Management of Parasitic Diseases of Freshwater Fishes” from 6 to 10 December 2017 at the Fish Health Laboratory of the Marine Research and Development Center, Sihanoukville, Cambodia, as requested during the SEAFDEC Council Meeting in 2017. Eleven staff from various aquaculture agencies in Cambodia attended the training. As per request from Lao PDR, on-site training course was also conducted on 20-24 November 2017 at Namxoung Aquaculture and Development Center, Namxoung, Lao PDR. A total of 15 participants from different institutions in Lao PDR participated. The lectures highlighted on the major bacterial and parasitic diseases currently affecting cultured freshwater fishes in the region. Hands-on exercises including fish necropsy, quantitative determination of parasite load in the gills and skin of fish and subsequent identification of the parasite present in the fishes examined were also carried out.

Additionally, an update on tilapia lake virus infection, an emerging and pressing problem currently besetting the tilapia aquaculture industry in Asia was presented. On the last day of the training, a field trip to a farm was conducted to observe the actual pond culture practices.



Demonstration of laboratory procedures on parasitology during the on-site training in Cambodia (left), and practical session during the on-site training on “Health Management of Parasitic Diseases of Freshwater Fishes” in Lao PDR (right)

THRUST 3. IMPROVING MANAGEMENT CONCEPTS AND APPROACHES FOR SUSTAINABLE FISHERIES

3.1 Combating Illegal, Unreported and Unregulated (IUU) Fishing

3.1.1 ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain

SEAFDEC/MFRDMD implemented since 2013 the project “**Combating IUU Fishing in the Southeast Asian Region through Application of Catch Certification for International Trade in Fish and Fishery Products**” to address the concerns faced by countries in the region on Illegal, Unreported and Unregulated (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.”

The “ASEAN Guidelines for Preventing the Entry of Fish and Fishery Product from IUU Fishing Activities into the Supply Chain” which was endorsed by the SEAFDEC Council and the SOM-37th AMAF in 2015, has since then been disseminated to the AMSs and served as basis for the countries in formulating policies and enabling the environment for preventing the entry of IUU fish and fishery products into the supply chain. Subsequently, MFRDMD organized in 2016 the first Regional Technical Consultation (RTC) where inputs from the AMSs on their existing fisheries management and issues encountered with respect to the different “forms of IUU fishing” were gathered, to come up with the recommendations for implementation of the Guidelines. Since then, promotion of the implementation of the Guidelines has been intensified, and in 2017, MFRDMD conducted a questionnaire survey on the current status, issues and possible actions to promote the implementation of the Guidelines. The feedbacks from six (6) AMSs to the questionnaire were summarized, and the results were presented during the “Second RTC on Promotion of the ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain” organized from 21 to 23 November 2017 in Kuala Lumpur, Malaysia. The RTC came up with the updated status of implementation of the ASEAN Guidelines based on the self-evaluation conducted by the respective AMSs as the first step to identify the country that needs the most assistance for the effective implementation of the Guidelines.



Participants attending the Second RTC on the Promotion of the ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain

3.1.2 ASEAN Catch Documentation Scheme (ACDS)

Another activity was carried out by SEAFDEC to support the implementation of the “ASEAN Guidelines for Preventing the Entry of Fish and Fishery Product from IUU Fishing Activities into the Supply Chain.” As one of the management tools for combating IUU fishing and enhancing the competitiveness of ASEAN fish and fishery products in the region, the “ASEAN Catch Documentation Scheme (ACDS)” was established for marine capture fisheries. Undertaken by MFRDMD in collaboration with the SEAFDEC Secretariat, the ACDS Concept was designed to enhance the traceability of marine capture fisheries in the ASEAN region, covering the domestic and international trades.

The ACDS includes five main documents, namely: 1) Catch Declaration (CD); 2) Movement Document (MD); 3) Catch Certification for exportation (CC); 4) Processing Statement; and 5) Re-export Certificate (RE). The ACDS Concept was endorsed at the 25th Meeting of the ASEAN Sectoral Working Group on Fisheries (25ASWGFi) held in May 2017, and subsequently adopted by the SOM-39th AMAF during the same year.

In 2017, SEAFDEC started to pilot test the application of the ACDS in Brunei Darussalam, where the basic information on the existing traceability procedures of fish and fishery products in the country was gathered during the “First Consultative Visit” in 2016. Results of the analysis had been used for the development by SEAFDEC of the electronic-ACDS (eACDS) with the cooperation of the Fish Market Organization (FMO) of Thailand. On 29 January-2 February 2017, the “Second Consultative Visit” was organized to introduce the draft eACDS and discuss the establishment of validation and Competent Authority Units for issuing the ASEAN/Brunei Darussalam Catch Certificate. Pilot testing of the ACDS in Brunei Darussalam was then officially launched during the Inaugural Ceremony of the 49th Meeting of the SEAFDEC Council in April 2017.

After the launching of the ACDS, the “First On-site Training on the Use of eACDS” was organized in Brunei Darussalam on 19-21 June 2017. Attended by relevant stakeholders, the Training focused on the use of web-based and mobile applications of the eACDS to issue Catch Declaration (CD) and Movement Documents (MD) for verifying the route of the fish catch in the supply chain, *i.e.* from sea to processors or local and domestic markets in Brunei Darussalam. Back-to-back with the training was the First eACDS Committee Meeting to discuss on the improvements of the operation and workplan. SEAFDEC then proceeded



Launching of ACDS pilot testing in Brunei Darussalam



Onsite training on the use of the eACDS

with the completion of the eACDS for Brunei Darussalam, which is meant not only for local and domestic markets, but also for the issuance of Catch Certification (CC) or ASEAN Catch Certification (ACC) for the export market. The “Second On-site Training” was subsequently convened on 17-18 October 2017 for DOF officers for them to transfer the knowledge on eACDS to various groups of stakeholders such as buyers, processors, and exporters in Brunei Darussalam, as well as the web-based and mobile applications for issuing the Catch Certification by the Competent Authority. This was followed by the “Second Meeting of the eACDS Committee for Brunei Darussalam” on 19 October 2017 to discuss and improve the system for smooth operation, as well as the future activity on monitoring and evaluation of the ACDS pilot testing activities in Brunei Darussalam.



Training on use of mobile applications for eACDS



Committee Meeting for the eACDS

For the other AMSs, SEAFDEC conducted a consultation visit to Malaysia on 22 March 2017 to introduce the process of developing the eACDS, and subsequently to Viet Nam on 28-29 October 2017 to introduce the eACDS to relevant stakeholders including the concerned governmental agencies, and the public and private sectors involved in the supply chain of fish and fishery products. As a result and upon the request from the D-Fish of Viet Nam, SEAFDEC introduced and demonstrated the eACDS to their officers on 4-5 December 2017 in Hanoi, Viet Nam. During the 2-day meeting, discussion was also made on the future plan to promote the application of eACDS in Viet Nam.



Consultation visit to Viet Nam

3.1.3 Management of Fishing Capacity

In response to the request of the AMSs, SEAFDEC intensified its efforts in developing the Regional Plan of Action (RPOA) for the Management of Fishing Capacity (RPOA-Capacity), which was endorsed during the 22nd ASEAN Sectoral Working Group on Fisheries in 2014. The RPOA-Capacity was subsequently endorsed by the 48th Meeting of the SEAFDEC Council and the 24th Meeting of the ASWGF in 2016, and adopted by the 38th Meeting of AMAF also in 2016. Since then, the AMSs that still do not have the NPOA-Capacity or similar approaches in place, have been encouraged to develop the respective countries' NPOA-Capacity. Meanwhile, SEAFDEC continued some activities related to this aspect, which is the

regional/sub-regional stock and risk assessment of neritic tunas, *i.e.* longtail tuna (*Thunnus tonggol*) and kawakawa (*Euthynnus affinis*) in Southeast Asia. From the results of the stock and risk assessments carried out in 2017, management measures have been developed by SEAFDEC which are applicable to the management of fishing capacity. The proposed management plan for the shared stocks of longtail tuna and kawakawa in the Southeast Asian region was subsequently noted by the SEAFDEC Council at its 40th Meeting and by the 25th Meeting of the ASEAN Sectoral Working Group on Fisheries (See 4.2 on *Regional Cooperation for Tuna Fisheries Management*). Recently, SEAFDEC in consultation with the Member Countries also exerted efforts in strengthening the sub-regional cooperation for management of fishing capacity by establishment Monitoring, Control and Surveillance (MCS) Network for the Gulf of Thailand, Northern Andaman, and Southern Andaman sub-regions by building upon the existing national initiatives.

3.1.4 Regional Fishing Vessels Record (RFVR)

In support the global initiatives in combating IUU fishing, SEAFDEC/TD implemented the project “**Promotion of Countermeasure to Reduce IUU Fishing,**” focusing on the development of the Regional Fishing Vessels Record (RFVR), and regional cooperation for the implementation of Port State Measures. To continue the compilation of the RFVR, TD convened in 2017 the “Regional Technical Consultation on Evaluation of Implementation and Utilization of the Regional Fishing Vessels Record (RFVR) for vessels 24 meters in length and over as a Management Tool toward Combating IUU Fishing in ASEAN” from 12 to 14 September 2017 in Bangkok, Thailand. Attended by the RFVR National Focal Points and policy makers from Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Singapore, Thailand, and Viet Nam, the RTC came up with: 1) updated information from the AMSs in reducing IUU fishing, 2) progress on the utilization, issues and problems related to the RFVR for vessels 24 meters in length and over, and 3) strategies and way forward for the improvement, promotion and utilization of the RFVR Database for vessels 24 meters in length and over, to prevent, deter and eliminate IUU fishing in the region.

SEAFDEC also supported the national initiatives in combating IUU fishing. In this connection, SEAFDEC provided technical support to the Fisheries Administration (FiA) of Cambodia in 2017, for the development of their fishing vessels licensing database system. Through their database system, Cambodia could easily share their vessels data with the RFVR Database.



Regional Technical Consultation on Evaluation of Implementation and Utilization of the RFVR for vessels 24 meters in length and over



On-site Training on Implementation of Fishing License Database System for FiA Cambodia

TD then organized the “On-site Training on Implementation of Fishing License Database System for FiA Cambodia” from 31 August to 1 September 2017 in Koh Kong Province, Cambodia in collaboration with the FiA. During the training, the structure of the fishing license database system as well as steps for accessing and providing raw data inputs to the database system were established.

3.1.5 Regional Cooperation to Support the Implementation of Port State Measures

Regional cooperation to support the implementation of Port State Measures (PSM) in the Southeast Asian region has been strengthened by SEAFDEC. Under the project “**Promotion of Countermeasure to Reduce IUU Fishing,**” discussions were facilitated by SEAFDEC/TD in collaboration with partners and relevant institutions, particularly FAO and the U.S. National Oceanic and Atmospheric Administration (NOAA) through the USAID-Regional Development Mission for Asia (RDMA), on the conduct of regional and onsite-training sessions to support the implementation of PSM in Southeast Asia. Although capacity building was identified as a priority for implementing the PSM, the training scheduled in 2017 was postponed to February 2018 due to difficulties in acquiring the resource persons on the subject matter. Moreover, while considering the recommendation of the 19th FCG/ASSP Meeting, SEAFDEC continued to seek the assistance from other relevant international organizations for the conduct a regional review of the national laws and regulations of the AMSs that could enhance the effectiveness of the implementation of PSM Agreement, by focusing on the identification of the legislative gaps in combating IUU fishing.

3.2 Promotion of the Ecosystem Approach for Fisheries Management (EAFM) and Responsible Fisheries Management

SEAFDEC/TD with support from various funding sources organized in 2017 a series of training courses to promote the application of the Ecosystem Approach for Fisheries Management (EAFM) as one of the approaches considered practical and applicable for fisheries in the countries of the region. One of the activities implemented through these EAFM training courses was the establishment of the “**Strategies for trawl fisheries bycatch management**” by TD from 2012 to 2016 with the objective of contributing to the more sustainable use of fishery resources and healthier marine ecosystems in the Coral Triangle and Southeast Asian waters by reducing bycatch, discards and fishing impacts from trawl fisheries. Although this project was completed in 2016, the “Essential Ecosystem Approach to Fisheries Management (EEAFM) Training Course” scheduled in late 2016 in Trat Province, Thailand was postponed to 16-21 January 2017. Representatives from Trat Provincial Fisheries Committee and stakeholders were expected to participate in the training course that aims to provide the concept and principles of EAFM through the practice of users’ group conflicts reduction, enhancement of cooperativism among stakeholders, and resolving fisheries issues and challenges. The training is also expected to come up with a draft EAFM plan for fisheries including trawling to support fisheries management plan in the activity pilot site.

In addition, a series of on-site trainings on Essential-Ecosystem Approach to Fisheries Management (EEAFM) were conducted in 2017 under the project “**Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia.**” These included:



EEAFM Training in Trat Province, Thailand



EEAFM Training in Ranong Province, Thailand



EEAFM Training in Bo Keo, Lao PDR



EEAFM Training in Kampot, Cambodia

1) Training Course on EEAFM for Thailand (6-11 November 2017, Ranong Province, Thailand); 2) Training Course on EEAFM for Lao PDR (4-8 December 2017, Bo Keo, Lao PDR); and 3) Training Course on EEAFM for Cambodia (18-22 December 2017, Kampot, Cambodia). More than 300 participants attended these training courses where the stakeholders' knowledge and understanding of the basic concept of EAFM were enhanced and the capacity of national staff had been strengthened to promote local management of the habitats and fisheries.

Recognizing the need to also enhance the capacity of the new generations on the EAFM concept, TD organized the "Short-term Training Course of University Students on Ecosystem Approach to Fisheries Management (EAFM)" on 6-16 June 2017 at its premises in Samut Prakan, Thailand. Aimed at building up the awareness of the new generation on EAFM



Shipboard training (left) and survey conducted at a fishery community in Rayong Province (right) as part of the EAFM training for university students

through responsible fishing for sustainable fisheries, the said training had 28 participants, comprising students from seven universities in Thailand and one from Hokkaido University in Japan.

3.3 Promotion of the fisheries *Refugia* concept

The South China Sea is a global center of shallow water marine biological diversity that supports significant fisheries that are important to food security and export incomes of the Southeast Asian countries. Accordingly, inshore waters of the South China Sea basin are subject to intense fishing pressure. With fish production being intrinsically linked to the quality and area of habitats and the heightened dependence of coastal communities on fish, a need exists to improve the integration of fish habitat considerations and fisheries management in the region. Taking into consideration the aforementioned circumstances, SEAFDEC/TD embarked in 2016 the 5-year project “**Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand.**” Funded by Global Environment Facilities (GEF), the project was executed regionally by SEAFDEC and UNEP in partnership with the government agencies responsible for fisheries in the six (6) participating countries, namely: Cambodia, Indonesia, Malaysia, Philippines, Thailand, and Viet Nam. The Project has the specific objective of “operating and expanding the network of fisheries *refugia* in the South China Sea and Gulf of Thailand for improved management of fisheries and critical marine habitats linkages in order to achieve the medium and longer-term goals of the fisheries component of the Strategic Action Programme for the South China Sea.”

Implementation of this project was aligned with the Regional Guidelines for Responsible Fisheries in Southeast Asia, particularly the “Supplementary Guidelines on Co-management Using Group User Rights, Fishery Statistics, Indicators and Fisheries *Refugia*,” as well as the recent regional policy guidance promoting the development of projects and initiatives aimed at ensuring more ecosystem-based approaches to fisheries management in the Southeast Asian region. The key anticipated results from this project include: establishment of operational management at 14 priority fisheries *refugia* in the six participating countries; strengthened enabling environments for the formal designation and operational management of *refugia*; enhanced national uptake of best practices in integrating fisheries management and biodiversity conservation; and strengthened cross-sectoral coordination for integrated fisheries and environmental management.

To proceed on the project implementation, Letters of Agreement were signed in 2017 with four out of the six participating countries, namely: Cambodia, Malaysia, Philippines, and Thailand; while for Indonesia and Viet Nam, this is still under process. To date, a total of eight priority fisheries *refugia* sites have been identified in three countries: (1) Cambodia: Kep Province - for blue swimming crab *refugia* in sea grass area; Preah Sihanouk Province - for juvenile grouper *refugia* in the coral reef area of Koh Rong Archipelago; and Koh Kong Province - for Indo-Pacific mackerel in transboundary area with Trat Province of Thailand; (2) Thailand: Trat Province - for Indo-Pacific Mackerel in transboundary area with Koh Kong Province of Cambodia; and Samui Archipelago in Surat Thani Province - for Indo-Pacific mackerel *refugia*; and (3) Philippines: Bolinao, Pangasinan - for siganus *refugia* in very large sea grass area; Masinloc, Zambales - for juveniles of Frigate tuna (*Auxis* spp.) *refugia*; and Coron, Palawan - for fusilier fish *refugia* in coral reef area, and mud crab *refugia* in mangrove area.

Site Level Inception Workshops and Baseline Data Collection were conducted in 2017 for three *refugia* sites in the Philippines, while Stakeholders Consultation Workshops were organized in Kep and Koh Kong Provinces of Cambodia.

From the activities carried out in 2017, major achievements had been attained. These included: (1) intensive series of consultations on the boundaries of fisheries *refugia* which have been supported by facilitated processes to identify key threats to fisheries *refugia* sites and initiate discussion about possible management measures for evaluation, *i.e.* governance reviews, stakeholder analyses, socio-economic information and data collation, and reviews of existing management arrangements that are still underway; (2) improvement of the management of critical habitats for fish stocks of transboundary significance via national and regional actions to strengthen the enabling environment and knowledge-base for fisheries *refugia* management in the South China Sea, *i.e.* development of working document for regional level review on key threats from fishing and the environment to fish stock and critical habitat linkages at the priority sites in the participating countries; existing regulations and by-laws in the areas of the eight (8) sites where the project is presently working, compiled and reviewed with feedback provided to national teams to aid in the formulation of recommendations on policy and legal reforms to support promotion of responsible fishing at times and at locations critical to fish stock and critical habitat linkages; workshops with local stakeholders and officials on policy and legal aspects of *refugia* (terminology, procedures, recommended reforms) in the participating countries that



Site Level Inception Workshop and Baseline Data Collection in Bolinao, Pangasinan, Philippines on 23-25 March 2017



Site Level Inception Workshop and Baseline Data Collection in Coron, Palawan, Philippines on 23-25 March 2017



Site Level Inception Workshop and Baseline Data Collection in Masinloc, Zambales, Philippines on 23-25 March 2017



Stakeholders Consultation Workshop in Kep Province, Cambodia, 22-24 August 2017



Stakeholders Consultation Workshop in Koh Kong Province, Cambodia, 12-14 September 2017

allowed discussions viewed through a more realistic lens to reflect the local stakeholders' needs, expectations, and concerns about socio-economic impacts of management; questionnaire survey templates prepared to: (a) compile and update information and data on the distribution of habitats, known spawning areas, locations of *refugia*, MPAs, fisheries management areas, and critical habitats for endangered species; (b) produce detailed site characterizations for the 14 priority fisheries *refugia* sites for incorporation into national and regional datasets, and preparation of detailed Terms of Reference for the development and application of a modeling system linking oceanographic, biochemical, and fish early life history information to improve regional understanding of fish early life history and links to critical habitats and discussion with regional universities, and internationally-recognized institutions with expertise in this field; (3) information management and dissemination in support of national and regional-level implementation of the fisheries *refugia* concept in the South China Sea, *i.e.* the *fisheries-refugia.org* web portal established and populated with newly developed short films, and journal articles written by regional project staff, all supported by various social media platforms including YouTube and Facebook, and a six-part short film social media campaign prepared and disseminated in December 2017; and (4) national cooperation and coordination for integrated fish stock and critical habitat management in the South China Sea were enhanced through the signing of Letters of Agreement with four out of the six participating countries, training of national teams in project management and governance arrangements, and following up on the progress of establishing agreements in eight out of 14 sites including the detailed terms of reference for site-based management boards.

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

The M.V. SEAFDEC 2 has been utilized since 2004 to support the Southeast Asian countries in conducting fishery resource surveys for better understanding of the marine fishery resources in their respective waters. SEAFDEC/TD carried out these surveys through the projects “**Fisheries Resource Survey and Operational Plan for M.V. SEAFDEC 2**” and “**Offshore Fisheries Resources Exploration in Southeast Asia.**” SEAFDEC also collaborated with universities in Japan for enhancing the human capacity of researchers from SEAFDEC and the Member Countries in conducting marine fishery resource surveys.

In 2017, TD responded to the request of Viet Nam for support in their national survey of small pelagic fish resources in Vietnamese marine waters using the M.V. SEAFDEC 2. Prior to the start of the survey, TD conducted the “Technical Meeting on the Utilization of M.V. SEAFDEC 2 for Cruise Survey on Small Pelagic Fish Resources in Marine Waters of Viet Nam” on 3-5 May 2017 in Viet Nam to prepare the detailed cruise plan, as well as administrative and financial arrangements for the cruise survey. The actual cruise survey which was conducted from 16 June to 23 August 2017, included: 1) hydro-acoustic survey in the Vietnamese marine waters; 2) sampling of small pelagic fishes using the mid-water trawl and bottom trawl at the survey stations; 3) oceanographic data collection, *i.e.* wind, wave, water temperature, salinity, turbidity, chlorophyll-a, and water current among others, at the survey stations; and 4) biological sampling for phytoplankton, zooplankton and fish larvae at the survey stations. Besides collection of samples for analysis of the small pelagic resources, the activity also provided on-the-job training opportunities for Vietnamese researchers to gain knowledge and experience on marine fisheries resources survey in particular, shipboard survey management, techniques for operation of bottom and mid-water trawls, as well as on the use of oceanographic instruments.

TD also helped in enhancing the cooperation between the Member Countries and the National Fisheries University (NFU) of Japan in conducting resource surveys. To follow-up on the collaborative research undertaken in Cambodian waters in 2016 between Cambodia, NFU and TD, where samples were collected for marine biology studies and fish larvae research, TD continued the activities in 2017 to enhance the capacity and skills of researchers from the Fisheries Administration (FiA) of Cambodia on fish larvae identification and ichthyoplankton study. Two researchers of FiA who were previously trained on fish larvae identification were invited to



Researcher of FiA Cambodia trained on fish larvae identification under supervision and technical support of SEAFDEC researchers and resource persons

the TD laboratory during 1-31 August 2017, where they underwent practical training on identification of fish larvae under the supervision and technical support from TD researchers and resource persons on the subject matter. From this activity, information on fish larvae in Cambodian waters was documented, while the researchers have built their capacity in identifying fish larvae up to the family or genus levels. It is expected that a report on the density of fish larvae in Cambodian waters would be finalized by September 2018.

A fishery oceanographer of TD joined the “21st Kaiyodai Antarctic Research Expedition (KARE21)” conducted by the Tokyo University of Marine Science and Technology (TUMSAT) of Japan, on-board its training vessel “Umetaka-Maru.” The Expedition departed from Fremantle (WA, Australia) on 31 December 2017 to the Southern Ocean, and back to Hobart (TAS, Australia) on 22 January 2018, covering the latitude 32°03.08 S - 66°12.80 S and longitude 106°43.91 E - 143°48.05 E. From the starting point, the cruise went southward along the 110°E transect for conductivity, temperature and depth profiler (CTD) observations and plankton sampling using various nets. After reaching the southernmost stations, the observational area spread westward to the continental shelf area for sea ice sampling. Sampling for microplastics was also undertaken on the way toward Hobart using a net. During the cruise, the TD oceanographer made observations of, and support the Umitaka-maru’s research activities, which is aimed at enhancing the experience and capacity of the TD staff in undertaking cruise surveys in the future.



TD Fishery Oceanographer during the cruise survey of the UM-17-09 expedition onboard the TR/V Umitaka-Maru

TD has also undertaken activities to promote sustainable resources utilization through the development of technologies on fish handling at sea. Based on the technologies it had developed, TD convened the “Regional Training Course on Fish Handling Techniques Applicable to Various Fishing Operations in Southeast Asia” on 11-15 December 2017 at its premises in Samut Prakan Province, Thailand. Attended by fourteen participants from the SEAFDEC Member Countries, the training course imparted the knowledge and skills on environmental-friendly fish handling tools, and simple techniques that could be applied to maintain the quality of catch on-board fishing vessels. The training also enhanced the awareness of participants on the need to reduce on-board post-harvest losses and promote food safety through the processes of storing and transportation of the fish.



Regional Training Course in Fish Handling Techniques Applicable to Various Fishing Operations in Southeast Asia

4.2 Regional Cooperation for Tuna Fisheries Management

Recognizing that the management of oceanic tunas is already covered by relevant RFMOs, the activities of SEAFDEC to support regional cooperation for management of tunas in the Southeast Asian region therefore focused specifically on neritic tunas. The Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region (RPOA-Neritic Tunas) which was developed by SEAFDEC in collaboration with the Member Countries and endorsed by the SEAFDEC Council and the ASWGFi Meetings in 2015 continued to serve as the framework for implementation of activities with respect to neritic tunas, particularly in coming up with better data and information on the status of neritic tuna resources for their sustainable utilization in the future.

Following up on the activities in 2016 focusing on the stock and risk assessment of longtail tuna (*Thunnus tonggol*) and kawakawa (*Euthynnus affinis*) in the Southeast Asian sub-regions, SEAFDEC conducted the “Working Group Meeting to Follow-up the Activities of the Joint Program on Tuna Research in Sulu and Sulawesi Seas” on 30-31 March 2017 in Bangkok, Thailand. Representatives from participating countries, namely: Malaysia, Indonesia, Philippines, as well as researchers from SEAFDEC and a resource person from Japan, attended the Meeting which came up with the updated progress of the tuna research works, direction and solutions to the difficulties on data analysis to support the tuna research in Sulu and Sulawesi Seas, and direction of future activities during 2017-2019.



Working Group Meeting to Follow-up the Activities of the Joint Program on Tuna Research in Sulu and Sulawesi Seas

To promote better understanding of the tuna stocks and of the sustainable utilization of neritic tunas in the region, a series of capacity building activities were conducted in 2017. These included the “Training-Workshop on Risk Assessment and Fisheries Management Framework-Measures of Longtail Tuna and Kawakawa in Southeast Asia” at the MFRDMD premises in Kuala Terengganu, Malaysia on 6-10 August 2017. The Training-Workshop was attended by representatives from Brunei Darussalam, Indonesia, Malaysia, Philippines, Thailand, and Viet Nam, as well as concerned staff from SEAFDEC. Carried out during the Training was the practical use of software for analyzing the stock assessments of longtail

tuna and kawakawa including CPUE standardization, stock assessment and management procedures based on the stock assessment results. Furthermore, the participants also reported on the status of development of national management frameworks for sustainable tuna fisheries in their respective countries, based on the RPOA-Neritic Tunas. The participants were then encouraged to transfer the methods learned from the Workshop to national scientists in their respective countries.



Training/Workshop on Risk Assessment and Fisheries Management Framework/Measures of Longtail Tuna and Kawakawa in Southeast Asia

Moreover, TD also organized the “Training Workshop on the Standard Methodology for Skipjack Otolith Collection” on 5-6 October 2017 at the Training Department in Samut Pakan, Thailand, with support from a lecturer from the National Research Institute of Far Seas Fisheries (NRIFSF) and the Fisheries Research Agency (FRA) of Japan. Attended by nine (9) researchers from Indonesia and TD, the training imparted to the participants the standard methodology and techniques to collect otolith from skipjack samples, and developed the framework for the study on skipjack growth analysis based on the examination of the intervals between daily rings in the otolith samples collected.



Training Workshop on the Standard Methodology for Skipjack Otolith Collection

The results and recommendations from the stock and risk assessments of longtail tuna and kawakawa in the Pacific Ocean and Indian Ocean were reported to the SEAFDEC Council during its 49th Meeting where the study results were noted while recommendations were made for the management of fishing capacity targeting these two species. The Meeting also recommended that further activities should be undertaken, *e.g.* establishing the number of fishing vessels from each AMS that target these species, and demonstration on whether neritic tunas in Indian Ocean as well as those in Pacific Ocean are of the same stock, as this would support the development of appropriate management measures for the species. The results and recommendations were also noted during the 25th ASWGF Meeting and subsequently submitted to the SOM-39th AMAF for notification.

In line with the aforementioned recommendations of the SEAFDEC Council, MFRDMD conducted in 2017 another study on the population structure of longtail tuna and kawakawa. The information on population structure of the species is considered essential for resources management of the species, and in determining to what extent, if any, the population of the species from this area is connected to the population elsewhere in the world. Thus, DNA specimens of longtail tuna and kawakawa would be collected at 12 landing sites of eight AMSs, namely: Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam, and the level of genetic diversity and population structure of the species would be identified using mitochondrial DNA displacement loop (D-loop) marker.

As of 2017, a total of 350 samples of longtail tuna and 400 samples of kawakawa were collected. For Malaysia, the DNA samples were collected from Kuantan, Kuala Perlis and Kota Kinabalu, while samples were also collected from Sihanoukville (Cambodia), Ranong and Trat Provinces (Thailand), and Vung Tau (Viet Nam) and sent to MFRDMD for DNA analysis. For Indonesia, sampling and DNA analysis would be conducted by the Research Institute of Marine Fisheries (RIMF) in Bogor, Indonesia. A meeting was convened in Jakarta, Indonesia on 17 January 2017 between MFRDMD and Indonesian researchers at RIMF to



Participants during the meeting between MFRDMD and Indonesian researchers at Research Institute of Marine Fisheries in Jakarta, Indonesia

discuss the project implementation. For other countries, collection of samples is still under way.

A total of 189 samples of longtail tuna collected from four locations, namely: Kuala Perlis (43 samples), Kuantan (43 samples), Sihanoukville (50 samples), and Vung Tau (49 samples) were analyzed using mtDNA D-loop gene. The preliminary results, which were presented during the “Fourth Meeting of the Scientific Working Group (SWG)



Sampling of longtail tuna DNA by a student with supervision from research officer

on Neritic Tunas Stock Assessment” on 7-9 November 2017 in Kuala Lumpur, Malaysia, indicated that longtail tuna in the South China Sea and Andaman Sea were homogenous with no significant genetic differentiation and the same genetic structure. However, more samples from the other sampling sites would be needed to confirm the initial findings.

4.3 Small Pelagic Fisheries Management

Small pelagic fishes such as the Indian mackerel, scads and sardinella are very important shared stocks in the Southeast Asian region that contribute to food security, as well as provide employment and livelihood opportunities for large number of fishers. Purse seine is one of the major fishing gears that catch these small pelagic fishes. However, management of purse seine fisheries is still neglected because the information on stocks and biological characteristics are lacking.

SEAFDEC/MFRDMD therefore implemented the project “**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 decades to examine the trends and status of stocks for purse seine fisheries. MFRDMD also reviewed the purse seine fishery management systems to examine the applicability of the systems for management of small pelagic fisheries in the region. Genetic study of the spotted sardinella (*Amblygaster sirm*), a small pelagic fish targeted by purse seine, was also conducted.

MFRDMD conducted the “Regional Workshop on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region” on 7-8 March 2017 in Kuala Lumpur, Malaysia. Although the application of systems, *i.e.* Total Allowable Catch (TAC) and Total Allowable Effort (TAE) had been promoted during the past years for management of the region’s purse seine fisheries, the Regional Workshop in 2017 introduced new management options, namely: the Allowable Biological Catch (ABC) and Allowable Biological Effort (ABE), considering that these two systems could be more suitable options for management of the multi-species fisheries situation of the region. Specifically, feedback controls were established using two assumptions, namely: (1) CPUE is proportional to the population, and (2) catch trend will correspond to short term population trend. These rules could serve as the most applicable and appropriate measures for the management of purse seine fisheries utilizing the data that are available.



Participants of the Regional Workshop on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region

MFRDMD also organized the “Third Core Experts Meeting on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region” on 12-14 September 2017 in Kuala Lumpur, Malaysia. The Meeting discussed the latest information on landings and CPUEs of purse seine fisheries in the region, the use of Total Allowable Catch (TAC) for management of multi-species fisheries, as well as the experience from the application of TAC system in Thailand and Target Reference Point (TRP) in the Philippines. The Meeting agreed that updated data on purse seine fisheries from the AMSs should be continuously collected by MFRDMD until the end of 2017, and such data should be examined during the regional synthesis workshop in order to come up with suggestions on the possible and suitable stock indicators and management measures for the region.



Third Core Experts Meeting on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region

During the Third Core Experts Meeting, the progress and preliminary results of the genetic study of *Amblygaster sirm* collected from eight (8) sampling locations, namely: Muara in Brunei Darussalam; Kuantan, Kuching and Kudat in Malaysia; Palawan and Bataan in the Philippines; and Songkhla and Ranong Provinces in Thailand. Based on such results, the concept of Fisheries Management Plan (FMP) for separate management unit of *A. sirm* in the Southeast Asian region was introduced.

As part of its activities on purse seine fisheries, MFRDMD collaborated with a post graduate student from the University of Hokkaido, Japan for the conduct of a preliminary survey on species composition of purse seine fisheries at five (5) major landing centers along the east coast of Peninsular Malaysia during 13-23 August 2017. Preliminary results from the survey were presented during the Third Core Experts Meeting on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region.



Spotted sardinella (Amblygaster sirm)



Report of the 2nd Core Expert Meeting on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region

The data on purse seine fisheries collected through this project until 2017 would be compiled and synthesized by MFRDMD, and the synthesis of purse seine fisheries in the region would be published in 2018. Final report of the genetic population study of *Amblygaster sirm* in the region would also be prepared. Furthermore, MFRDMD is also planning to convene the “Fourth Core Expert Meeting on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region” in 2018 to update the information gathered during the project period, and discuss the management measures exclusively for purse seine fisheries considering that small pelagic species, acknowledged as a vital shared stock of the region, are impacted by purse seine fisheries.

4.4 Research and Management of Sharks and Rays

During the past decades, several species of marine animals had been considered under international concern. These include among others, 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 in the CITES Appendices. From 2013 to 2017, twenty-seven (27) species of pelagic sharks and rays have been proposed for listing under CITES, with 12 species of sharks (*Carcharodon carcharias*, *Cetorhinus maximus*, *Rhincodon typus*, *Sphyrna lewini*, *S. mokarran*, *S. zygaena*, *Carcharinus longimanus*, *C. falciformis*, *Alopias pelagicus*, *A. vulpinus*, *A. superciliosus*, and *Lamna nasus*) and two species of manta rays (*Mobula birostris* and *M. alfredi*), and all nine species of *Mobula* rays (*Mobula kuhli*, *M. thurstoni*, *M. japanica*, *M. tarapacana*, *M. mobular*, *M. hypostoma*, *M. rochebrunei*, *M. munkiana*, and *M. eregoodootenke*) have been accepted for listing in Appendix II of CITES. All five species of sawfishes (*Pristis pristis*, *P. clavata*, *P. pectinata*, *P. zijsron*, and *Anoxypristis cuspidata*) are already listed in Appendix I of CITES. It has therefore become necessary for the Southeast Asian region to come up with justifications to avert future proposals to list the region’s economically-important species of sharks and rays in the CITES Appendices.

As means of addressing the global concern on sharks and rays, SEAFDEC/MFRDMD and TD have collaborated to implement the projects “**Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region**” and

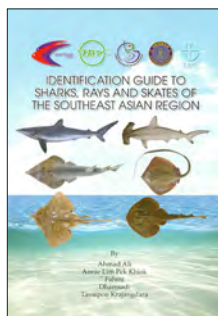
“Improvement of Data Collection of the Commercially Exploited Aquatic and Threatened Species.” Implemented from 2013 and scheduled for completion in 2019, these two projects are aimed at assisting the countries to collect sharks landing data and coming up with a regional picture that could serve as basis for reporting catch and landing of sharks and rays in the countries’ national fisheries statistics at species level and thus, facilitate international trade of sharks and rays in the future. In addition, the one-year project **“SEAFDEC-EU Regional Project on Sharks and Rays Data Collection”** was also undertaken in 2015-2016 to compile relevant data in seven countries, namely: Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam, based on the Standard Operating Procedures (SOPs) on Sharks Data Collection in Southeast Asian Waters. The collected regional data was used to support discussions during the “Technical Meeting on Determining the Appropriate Model for Assessment of Shark Stocks Based on Existing Data from the Southeast Asian Countries” on 7-8 June 2017 in Bangkok, Thailand, for the development of appropriate stock assessment model for selected shark species. Discussions were also made among the resource persons and stock assessment researchers from the Southeast Asian countries on the appropriate method for shark stock assessment during the “Technical Consultation Meeting on Shark Stock Assessment and Improvement Data Collection in Southeast Asian Region” on 18-20 September 2017 in Bangkok, Thailand. During the latter Technical Meeting, it was agreed that the Yield Per Recruit (YPR) model should be considered as the most appropriate method for examining the resource and fishery status of sharks and rays in the region. The Meeting also came up with a workplan for the conduct of stock assessment training workshop in order to promote the use of YPR model for sharks and rays in the SEAFDEC Member Countries. The regional network of shark and ray scientists and stock assessment researchers were also established with online communication for sharing of information and knowledge.



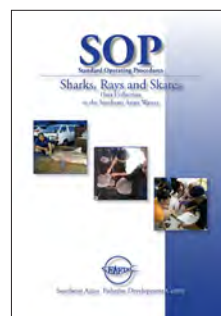
Technical Consultation Meeting on Shark Stock Assessment and Improvement Data Collection in Southeast Asian Region

Besides the development of stock assessment model, SEAFDEC also convened the “Technical Workshop on Improvement of Regional Fisheries Statistics on Sharks” on 13-15 June 2017 in Siem Reap, Cambodia, to discuss the updated data, summarize the information based on existing data, and assess the on-going regional initiatives of SEAFDEC related to sharks to clarify the areas for improvement and identify the future challenges for SEAFDEC in supporting the management of sharks in Southeast Asia through the regional fisheries statistics. The Workshop also developed the way forward for improving the information on sharks landing in the future.

Based on the activities undertaken by MFRDMD and TD since 2013, several information materials were produced for printing, *i.e.* “Identification Guide to Sharks, Rays and Skates of the Southeast Asian Region”; Standard Operating Procedures on “Sharks, Rays and Skates Data Collection in the Southeast Asian Waters”, “DNA barcoding reveals species of sharks in Malaysia and Viet Nam,” “DNA barcoding reveals species of rays in Malaysia and Viet Nam,” Terminal Report on “Sharks, Rays and Skates Data Collection in the Southeast Asian Waters (2015-2016)” in Malaysia, Myanmar, Thailand, Cambodia, Indonesia, and Viet Nam, as well as a number of information papers to disseminate the information and outputs from the projects on sharks and rays undertaken by SEAFDEC.



Identification Guide to Sharks, Rays and Skates of the Southeast Asian Region



SOP on Sharks, Rays and Skates Data Collection in the Southeast Asian Waters

Nevertheless, based on the one-year data collection on sharks and rays, it was noted that data in some countries are still insufficient to support fishery management. Therefore, a follow-up 12-month (2017-2018) “Study on Taxonomy and Biology Using Morphometric and Meristic Data, and DNA Barcoding Methods” would be carried out in several landing sites in Viet Nam (Vung Tau and Binh Dinh) and Cambodia (Preah Sihanouk), as well as in Malaysia (Pahang, Perak and Sabah). The Technical Meeting on Sharks and Rays Data Collection Planning 2017-2018 was convened on 22 June 2017. Subsequently, to enhance the capacity of the staff of the Member Countries on elasmobranch taxonomy and biology as well as on the technique in data collection of sharks and rays up to species level, MFRDMD organized the “Regional Training and Workshop on Chondrichthyans Taxonomy, Biology and Data Collection” on 13-17 August 2017 at MFRDMD, in Kuala Terengganu, Malaysia. An “On-Site Training on Chondrichthyans Taxonomy and Biology” was also organized from 26 to 29 September 2017 in Vung Tau, Viet Nam. After attending the training and workshop, enumerators from Cambodia and Viet Nam became more confident to start data collection up to species level, as well as in the verification and analysis of the data collected. The 1-year data collection in Viet Nam would be supported by MFRDMD and the data collection in Cambodia by TD.

MFRDMD also proposed to conduct a “Survey on Fishers Dependencies, Marketing and Trade of Sharks and Rays in Java and Sumatera, Indonesia,” taking into account the descriptive analysis of secondary data from local and federal fisheries statistics office or customs data, as well as marketing channel analysis. In this regard, MFRDMD proposed



Regional Training and Workshop on Chondrichthyans Taxonomy, Biology and Data Collection held in Kuala Terengganu, Malaysia



On-Site Training on Chondrichthyans Taxonomy and Biology held in Vung Tau, Viet Nam

to visit the Research Center for Fisheries and the Research Center for Socio-economic of Marine and Fisheries in Jakarta, Indonesia, to discuss with relevant government officers the planned survey, and to visit the landing sites at Cilacap, and Pelabuhan Ratu, as well as markets in Surabaya and Semarang in October 2017. However, these activities were postponed to 2018.

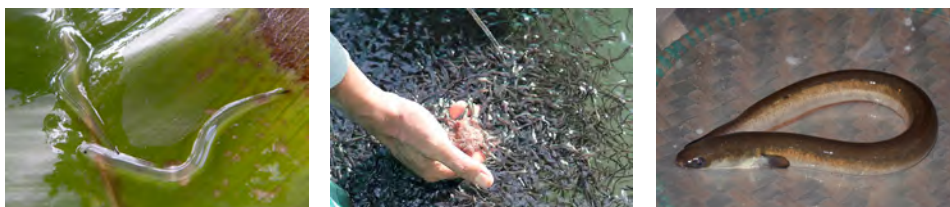
4.5 Conservation and Management of Eel Resources

Catadromous eels (*Anguilla* spp.: Anguillidae) are popular as important commercial food, due to their nutritional value and preference especially in East Asian countries. With the rapid decline of temperate eels, and the listing of some anguillid eel species, *i.e.* *Anguilla anguilla* and *A. japonica* in the CITES Appendices, the market value of tropical eels has risen during the recent years. Capture of glass eels (juvenile stage of anguillid eels) in tropical zone has also increased dramatically, posing risks for listing of these eel species in the CITES Appendices in the future. Several Southeast Asian countries therefore issued regulations to prohibit the exportation of eel seeds including glass eels in order to avoid over-exploitation of the species.

At the regional level, the project “**Enhancement of Sustainability of Catadromous Eel Resources in Southeast Asia**” was implemented by SEAFDEC/IFRDMD since 2015 with a view of enhancing the sustainability of anguillid eel resources in Southeast Asia. Under this project, the “Regional Policy Recommendations on Conservation and Management of the Eel Resources and Promotion of Sustainable Eel Aquaculture” was developed and endorsed by the SEAFDEC Council and the ASWGFi at their annual meetings in 2015. The project also supported the conduct of field surveys and holding of international workshop in 2016, to gather the essential and latest information on anguillid eel fisheries, including the commodity chain and demand-supply relationships of the eel seeds in this region.

Subsequently in 2017, SEAFDEC also commenced another project “**Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia**” funded by the Japan-ASEAN Integration Fund (JAIF) with the overall objective of strengthening and consolidating the eel resource management framework for sustainability of eel production from eel capture fisheries and eel farming in AMSs. Under this project, the “Project Preparatory Meeting” was organized by SEAFDEC Secretariat in collaboration with IFRDMD on 9 June 2017 in Palembang, Indonesia. Upon receiving the final approval from JAIF in July 2017, the “Project Planning Meeting” was organized on 4 August 2017 in Bangkok, Thailand to discuss the ways and means of improving the method of eel statistics collection to better understand the status of utilization of tropical anguillid eels, develop and disseminate aquaculture technology to increase the survival of eels, and formulate a joint management system for eel resources in Southeast Asia.

In the Southeast Asian region, five countries have anguillid eel fisheries in place, namely: Cambodia, Indonesia, Myanmar, Philippines, and Viet Nam. Out of these, four countries (except Cambodia) have juvenile anguillid eel fishery to supply the eel seeds for aquaculture. In 2017, the project therefore conducted field surveys in these countries specifically to obtain a clear understanding of the current situation of catadromous eel resources, fisheries and utilization in Southeast Asia. The surveys were conducted in the Philippines on 14-18 July 2017; Cambodia from 28 August to 1 September 2017; Indonesia on 9-13 October 2017; and in Myanmar on 23-28 October 2017. Findings from the surveys would not only serve as basis for the establishment of catadromous eel data collection system, but also provide the fundamental information for planning of regular eel surveys in the future.



Glass eels (left), elvers (middle), and yellow eel (right)

From the surveys, it was found that in some eel seed fishing grounds, *e.g.* in Palabuhan Ratu, West Java Indonesia, the local government has established a system of collecting catch statistics on anguillid eels including eel seeds. However, such system of data collection has some oversights, including the absence of indices on fishing efforts for CPUE calculations.

Moreover, in other fishing grounds for eel seeds, such as in Myanmar and Philippines, the catch statistics specifically on juvenile anguillid eels are not collected, and as a result the exact quantity of eel seeds being harvested during each fishing season is not known. This could be one of the severe weaknesses in the region in coming-up with measures to avoid the listing of tropical anguillid eel species into the CITES Appendices. Nevertheless, IFRDMD planned to develop a harmonized data collecting system in order that the four countries could come up with catch statistics, with indices on fishing efforts.

Based on the initial survey results, IFRDMD convened the the “Meeting on Progressive Results of Implementation Activities on Anguillid Eels” on 11 December 2017 in Palembang, Indonesia; and the “First Meeting of Assessment Committee” on 19 December 2017 in Bangkok, Thailand. Furthermore, verification of the results from the surveys would be discussed during the “Second Meeting of Assessment Committee” and “Second Regional Meeting for the JAIF Project on Anguillid Eels” scheduled in 2018.

4.6 Improving Information and Statistics Collection for Management of Fisheries

The project “**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.

For the sub-project “**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 were first reviewed. Then, training to facilitate fisheries information gathering through the introduction of community-based resources management/co-management was organized. In 2017, TD promoted the innovative fisheries management approaches including community-based resources management/co-management at project sites in Cambodia, Lao PDR, and Thailand.

For Cambodia, Chong Khneas Commune in Siem Reap was selected as a project site to promote and implement “Co-management and Community-based Fisheries Management.” To start off the activity, TD conducted a baseline survey in collaboration with the Fisheries Administration (FiA) on 20-25 March 2017 by interviewing fishers in Angkaul Village, Kep Province to gather information on the community situation and the main issues in the target area, and develop the project workplan and activities. Based on results of the



Meeting with the Kep Provincial Fisheries Cantonment during the baseline survey



Training on Fiber Glass Boat Construction to support eco-tourism activity

baseline survey, TD convened the meeting “Improvement Conservation Zone and Promote Eco-tourism” in Chong Khneas Commune, Siem Reap on 15-20 May 2017. Training on fiber glass boat construction was also organized for twenty (20) participants from Chong Khneas Commune with the aim of providing knowledge on fiber glass boat construction to support the study “Monitoring in Narrow Water Conservation Zone” through “Support Eco-tourism Activity.”

The project site in Lao PDR was in Khammouane Province, and to follow-up on the baseline survey conducted at the end of 2016, TD started the activities toward establishment of the Fisheries Management Committee (FMC) and promotion of co-management/community-based fisheries management (CBFM) by arranging an event to disseminate the concept of co-management and CBFM to the local people at the project site on 27-31 March 2017. Subsequently, the meeting to establish FMC was convened on 22-26 May 2017 in collaboration with the Department of Livestock and Fisheries (DLF) of Lao PDR. As a follow up, monitoring of the established FMC and survey of fish market were also carried out during 2-6 October 2017, together with the declaration of a fisheries conservation area with rules and regulations, established for and by local people and stakeholders in the pilot site.



Monitoring of the established FMC and survey on fish markets in Khammouane Province, Lao PDR

In Thailand, the pilot site of the project was in Nam Oon Dam, Sakon Nakhon Province. In 2014, TD collaborated with the Department of Fisheries (DOF) of Thailand to implement a CBRM project in the project site located in northeast Thailand. Nam Oon Dam was established in 1981 with water volume of about 520 million m³, used to supply the water requirements of the agriculture sector of the Province. Nam Oon Dam was proposed by the DOF Thailand as the pilot site of the project because many outsiders who are not concerned about the need to conserve the fishery resources, fish in Nam Oon Dam. In addition, illegal fishing has been reported to occur in the Dam, where these illegal fishers use the mechanical giant lift net, a cone shaped stationary fishing gear submerged at a certain depth with the opening facing upwards. Moreover, the local government has deemed it necessary to define the conservation zone in Nam Oon Dam for the sustainability of the fishery resources in the Dam.

Based on the results of the baseline survey conducted in July 2014 to understand the condition of the communities as well as their existing problems, the sixteen communities around Nam Oon Dam engaged in fisheries as well as in agriculture (paddy field, rubber tree, cassava, among others), have been involved in the project. Results of the baseline survey indicated that the main fishing gears used in the Dam include gill net, hook and line, and fish trap, catching major freshwater fish species such as the Siamese mud carp, Indian river barb, and common silver barb, which are mostly intended for household consumption or sold in the local markets. After establishment of the inland fisheries management committee for Nam Oon Dam, the committee members were selected and trained to build their awareness on the importance of CBRM and the need to promote the conservation of fishery resources in Nam Oon Dam. A workshop for the inland fisheries management committee of Nam Oon Dam was then organized to define the fisheries management measures and enhance the committee's knowledge on inland fisheries management and the fisheries law, regulations on fishing gears and methods, as well as develop the conservation area and closed season imposed during the fish spawning season from 16 April to 15 August.

The fisheries management measures developed by the committee were announced through signboards put up in the communities around Nam Oon Dam that contain the map of Nam Oon Dam, closed season period, the allowed date for fishing, prohibited fishing gears, conservation zone, and fishing gears allowed to be used in open and closed season. Local meetings were regularly organized to explain the fisheries management measures that were displayed in the signboards that have been set up by the management committee with the involvement of the community members.

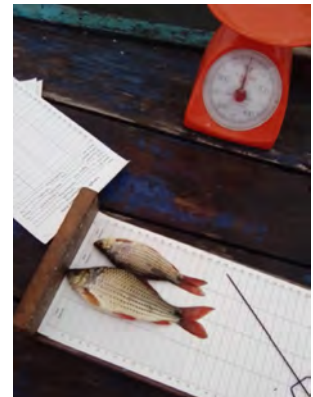
Results of the resource assessment and data collection initiated in March 2017 in four selected communities, namely: Ban Dong Khampho, Ban Kudtakap, Ban Klang, and Ban Nachuak which included the analyzed catch data indicating the current status of fishery resources in Nam Oon Dam, would be shared with the fishers for feedback and would be used as scientific reference for the development of the fisheries management measures. Based on the agreement among the communities for habitat restoration and protection of fishery resources, the conservation zone in Nam Oon Dam was designated. Covering an area of about 1,028,800 m² and located between Ban Dong Khampho and Ban Nachuak, the

conservation zone would be marked using the 15 buoys provided by TD to serve as markers for the conservation zone as well as to indicate the border between the two communities.

A follow up activity on the promotion of Community-based Fisheries Management/Co-management in Nam Oon Dam, Sakon Nakhon Province was carried out through an on-site training organized on 20-24 February 2017, where TD supported the fishing community through the installation of buoys to serve as signs to demarcate the conservation zone at Ban Thaichareon Village. Monitoring of the status of the fishery resources in Nam Oon Reservoir was also conducted through the research study on stock assessment which started in March 2017 with the actual collection of data including contemporary catch data from the logbooks used by fisher volunteers. A follow up activity was organized during 26-30 June 2017.



Installation of sign buoys to mark the conservation zone



Data collection for stock assessment study

With regards to the **“improvement of data collection of the commercially exploited aquatic and threatened species,”** activities were implemented by TD in collaboration with MFRDMD to support data collection on “sharks and rays” and develop stock assessment methods as well as management measures of the species based on the existing data on sharks and rays in Southeast Asian countries (See 4.4 on *Research and Management of Sharks and Rays*).

For the “*harmonization of fishery statistics in the Southeast Asian region*,” SEAFDEC Secretariat continued to coordinate with the Southeast Asian countries and relevant organizations to facilitate submission of national statistics for regional/international compilation. To facilitate harmonization of regional statistics with those of the international level, SEAFDEC took part in the “Coordinating Working Party on Fishery Statistics (CWP) Intersessional Meeting - Aquaculture and Fisheries Subject Group” on 19-21 June 2017 in Copenhagen, Denmark, where views on the fishery statistics situation of the region were shared. Through this Meeting, SEAFDEC was updated on the development of new global standards, classifications and definitions used in compiling fishery statistics. With regards to production of the publication “Southeast Asian State of Fisheries and Aquaculture (SEASOFIA),” the draft SEASOFIA which was tabled for discussion/consideration at the SEAFDEC Program Committee at its 39th Meeting in November 2016 was finalized; and the publication was published and disseminated in 2017.



Fishery Statistics Bulletin of Southeast Asia 2015 and the SEASOFIA 2017 issued in 2017

In 2017, SEAFDEC also organized the “Regional Technical Consultation on Fishery Statistics and Information in Southeast Asia” on 15-18 August 2017 in Bangkok, Thailand, which came up with updated status and suggestions to improve the reporting of national statistics from AMSs for regional compilation. The Consultation also noted the requirements for improving the collection and reporting of the statistics, *e.g.* for migratory species and species under international concern, for regional compilation. Update on the development of global standards on fishery statistics, *i.e.* the International Standard Statistical Classification of



RTC on Fishery Statistics and Information in Southeast Asia in 2017

Fishing Gears (ISSCFG), International Standard Statistical Classification of Aquatic Animal and Plants (ISSCAAP), and the new standard questionnaires on aquaculture statistics were also discussed for incorporation in the region's fishery statistics framework in the future.

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 and regional levels over the past decades, with a number of international instruments including market-driven measures agreed upon and applied by relevant organizations or 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 U.S. Presidential Taskforce on Combating IUU Fishing and Seafood Fraud; and the more stringent need and emerging instruments for ensuring the sustainable utilization of fishery resources of the region. Supported by the SEAFDEC Departments, the SEAFDEC Secretariat implemented the project “**Assistance for Capacity Building in the Region to Address International Fish Trade-related Issues**” to enhance the understanding and capacity of the Member Countries in addressing the aforementioned issues and requirements. 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.

In 2017, SEAFDEC continued to facilitate the implementation of regional guidelines and policy recommendations that had been previously endorsed by the SEAFDEC Council and the high-authorities of the ASEAN, particularly the ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain, the ASEAN Catch Documentation Scheme (ACDS), and the tools developed at the regional level to support the countries in combating IUU fishing, *i.e.* the Regional Plan of Action for the Management of Fishing Capacity, Regional Fishing Vessels Record (RFVR) for vessels 24 meters in length and over, and the Regional Cooperation for Implementation of the Port State Measures (*See 3.1 on Combating Illegal, Unreported and Unregulated (IUU) Fishing*).

SEAFDEC also continued to promote the ASEAN Catch Documentation Scheme (ACDS) including the electronic and mobile applications of the ACDS. The ACDS Concept developed by SEAFDEC was endorsed at the 25th Meeting of the ASEAN Sectoral Working Group on Fisheries held in May 2017, and subsequently adopted by the SOM-39th AMAF during the same year. Pilot implementation of the ACDS also commenced in 2017 starting from Brunei Darussalam (*See 3.1.2 on ASEAN Catch Documentation Scheme (ACDS)*).

On CITES-related issues, particularly in relation to the commercially-exploited aquatic species such as neritic tunas, sharks and rays, and anguillid eels, several technical projects of SEAFDEC were continued, to enhance the capacity of countries to collect data and information of the species and come up with regional synthesis that could support future discussion at the international fora (*See 4.2 Regional Cooperation for Tuna*

Fisheries Management; 4.4 on Research and Management of Sharks and Rays; and 4.5 on Conservation and Management of Eel Resources).

In order to monitor the progress made in addressing international fish trade-related issues that could impact on the fisheries of the region, SEAFDEC participated in relevant events, namely:

- Seminar on Traceability for Marine Capture Fisheries (22-23 May 2017 in Hokkaido, Japan)
- 1st Meeting of the Parties to the 2009 FAO Agreement on Port State Measures (29-31 May 2017 in Oslo, Norway)
- UN Ocean Conference (Organized by the United Nations on 5-9 June 2017 in New York, USA)
- 29th Meeting of the Animals Committee for CITES (18-22 July 2017 in Geneva, Switzerland)
- FAO Regional Advocacy Event for Monitoring the SDGs related to Food and Agriculture Sector (4-6 September 2017 in Bangkok, Thailand)
- 16th Meeting of the FAO Sub-Committee on Fish Trade (4-8 September 2017 in Busan, Republic of Korea)
- International Symposium on Fisheries Science for Future Generation (22-25 September 2017 in Tokyo, Japan)
- 4th ASEAN-EU High-level Dialogue on Maritime Security Cooperation (5-6 October 2017 in Manila, Philippines)
- FAO Regional Workshop on International Fish Trade, Markets and Governance (14-15 December 2017 in Shanghai, China)

The participation of SEAFDEC in relevant international meetings enabled SEAFDEC to obtain information on the movements at international levels, and enhance the readiness of countries in the region to respond to the emerging requirements in the future.

6. SPECIAL PROJECTS

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

SEAFDEC has been implementing the project “**Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia**” with support from the Government of Sweden, the original project period of which was five years from January 2013 to December 2017. In 2016, the SEAFDEC-Sweden Project period was extended for two years until 31 December 2019. While the overall aim of this project is to achieve sustainable use of aquatic resources and reduce vulnerability of coastal/rural (fishing) communities in the ASEAN region, activities are being implemented to build-up the capacity of AMSs in achieving the specific output objectives, such as the following:

- Output objective 1 Capacity built for integration of habitat & fisheries management, and adaptation to climate change
- Output objective 2 Capacity built and systems improved for the management of fishing capacity (monitoring; record and control)

Output objective 3 Capacity built and policy development processes improved for drafting and implementing regional & sub-regional agreements

In 2017, the SEAFDEC-Sweden Project facilitated the conduct of consultations among the AMSs on ASEAN priority issues at the regional, sub-regional and sub-sub-regional levels. Progress has been made on the main thematic areas and cross-cutting issues, namely: sustainable utilization of neritic tunas; management of fishing capacity; gender and labor, and working conditions in fishing; and small-scale fisheries. Activities were also pursued through contract engagements for local capacity building, including the updates on the relevant activities in the four target sub-regions, namely: Gulf of Thailand, Andaman Sea, Mekong River Basin, and Sulu-Sulawesi Seas.

Output objective 1: Capacity built for integration of habitat & fisheries management, and adaptation to climate change

- **Sustainability of transboundary species through the implementation of the Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region (RPOA-Neritic Tunas)**

Since the adoption of the Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region (RPOA-Neritic Tunas) in 2015 and the establishment the Scientific Working Group (SWG) on Neritic Tunas Stock Assessment, the SWG has been playing the important role of providing scientific information to be used as basis for the development of management plans, and improved assessments on the availability, distribution and migration of neritic tuna to increase understanding on stock status and migration paths for neritic tunas in the Southeast Asian waters. In 2017, the SEAFDEC-Sweden Project supported the conduct of several activities under the framework of the RPOA-Neritic Tunas. These include the following:

- Population Study of *Thunnus tonggol* in the Southeast Asian Region (1 October 2017-30 September 2018)
- Training/Workshop on Risk Assessments and Fisheries Management Framework/ Measures of Longtail Tuna and Kawakawa in Southeast Asia (6-10 August 2017 in Kuala Terengganu, Malaysia)
- 4th Scientific Working Group on Neritic Tunas and Advanced Training Course on Risk Assessment of Longtail Tuna and Kawakawa in the Southeast Asian Waters (7-9 November 2017 in Kuala Lumpur, Malaysia)

The progress, including results and recommendations from the implementation of the RPOA-Neritic Tunas was reported to the SEAFDEC Council at its 49th Meeting, the results and recommendations of which were also noted by the 25th ASWGF Meeting and subsequently by the SOM-39th AMAF in 2017.

- **Improving awareness and enhancing capacity on Ecosystem Approach to Fisheries Management**

The SEAFDEC-Sweden Project supported the conduct of a number of on-site training courses in 2017 to promote the Ecosystem Approach to Fisheries Management (EAFM), namely:

- Training Course on Essential EAFM for Thailand (6-11 November 2017, Ranong Province, Thailand)
- Training Course on Essential EAFM for Lao PDR (4-8 December 2017, Bo Keo, Lao PDR)
- Training Course on Essential EAFM for Cambodia (18-22 December 2017, Kampot, Cambodia)

The overarching objectives of these training courses were to provide knowledge and understanding of the basic concept of EAFM and to strengthen the capacity of national staff for local management of habitats and fisheries. More than 300 people from targeted sub-regions (Gulf of Thailand, Andaman Sea and Mekong River Basin) have availed of these training courses.

- **Management of transboundary resources/stocks through sub-regional approaches**

For the ***Gulf of Thailand Sub-region***, the dialogues among Cambodia, Malaysia, Thailand, and Viet Nam, and bilateral dialogues between these countries, came up with the agreement to develop the management plan for important transboundary resources/stocks, namely: anchovies; Indo-Pacific mackerels, and blue swimming crab or AIB species around the Gulf of Thailand. A series of capacity building activities were conducted in 2015-2016 to support the data collection of these species; and the “Experts Group Meeting on Stock Status and Geographical Distribution of AIB Species in the Gulf of Thailand” organized in September 2016 agreed to adopt the Standard Operation Procedures (SOPs) for Data Collection and Analysis in order to harmonize the data collected and compiled on these species.

As a follow-up of the activities in 2016, the SEAFDEC-Sweden Project conducted the “Planning Meeting on Development of Stock Study for AIB-Species in the Gulf of Thailand” on 7-8 February 2017 in Bangkok, Thailand, to develop the plan for the stock study on the AIB species and to explore the possibility of developing a joint management plan for AIB species in the Gulf of Thailand based on available information. However, the Meeting viewed that the study conducted by Thailand to collect information on the stock structure of Indo-Pacific mackerel has insufficient number of samples, and suggested that SEAFDEC should facilitate the completion of the needed information.

In response, the SEAFDEC-Sweden Project organized an “Inception Meeting for DNA Study on Stock Structure of Indo-Pacific Mackerel in the Gulf of Thailand” on 13-14 December 2017 in Rayong Province, Thailand to discuss and finalize the activity plan as well as the use of Standard Operation Procedures (SOPs) for sample collection and tissue sampling in region. Attended by the national focal points from the four countries in the Gulf of Thailand together with staff from SEAFDEC/TD and the Secretariat, the Meeting agreed that tissue samplings would be conducted in their respective countries in 2018.



Inception Meeting for DNA Study on Stock Structure of Indo-Pacific Mackerel in the Gulf of Thailand on 13-14 December 2017, Rayong Province

For the **Andaman Sea sub-region**, the AIB initiative was introduced during the Northern and Southern Andaman Sea Consultative Meetings on 16-17 November and 21-22 November 2017, respectively. The Meetings supported the sub-regional cooperation for management of transboundary resources on target species such as anchovies, mackerels (*R. Brachysoma* and *R. kanagurta*, and neritic tunas (kawakawa and longtail). During these Meetings, the countries also agreed on the key actions for 2018, *i.e.* to review the available information on these target species to be used as basis in the development of the management plans.

Output Objective 2: Capacity built and systems improved for the management of fishing capacity (monitoring; record and control)

- **Combating IUU fishing and management of fishing capacity**

In 2017, the SEAFDEC-Sweden Project continued the initiatives in collaborating with partners to combat IUU fishing, particularly through monitoring and control of fishing efforts. Issues concerning the progress on the management of fishing capacity had been addressed through bilateral dialogues and sub-regional consultations among the concerned countries.

For the **Gulf of Thailand Sub-region**, discussions were continued during the 6th Meeting of Gulf of Thailand Sub-region (28 February-2 March 2017, Bangkok, Thailand), the 2nd



6th Meeting of Gulf of Thailand Sub-region



2nd Sub-regional Technical Meeting on Effective Fisheries Management between Malaysia and Thailand

Sub-regional Technical Meeting on Effective Fisheries Management between Malaysia and Thailand (25-26 July 2017, Bangkok, Thailand), and the Technical Meeting of the Joint Working Team for Fisheries Management between Cambodia and Viet Nam (17-18 October 2017, Phnom Penh, Cambodia). The issues discussed specifically focused on monitoring of catches and landings, and raising awareness on the procedures and systems for enhancing traceability of fish and fishery products. In addition, discussions were also made on sharing of information on the latest laws and legislations related to managing fishing capacity and reduction of IUU fishing, such as licensing system, procedures in catch landing, and inspection of foreign vessels landing across the borders.

The SEAFDEC-Sweden Project also conducted the “Sub-regional Consultation on MCS in the Gulf of Thailand Sub-region” on 31 October-2 November 2017 in Chonburi, Thailand with the aim of sharing information on the national frameworks for monitoring, control and surveillance among countries in the Gulf of Thailand sub-region. During the Consultation, representatives from participating countries agreed to collaborate with responsible agencies to secure the mandate and approach to establish the sub-regional MCS network that links among existing national networks, which should be operational by mid 2018.



Sub-regional Consultation on MCS in the Gulf of Thailand Sub-region



Third Sub-regional Consultative Workshop of the Northern Andaman Sea/Myeik Archipelago

For the **Andaman Sea sub-region**, issues on monitoring and control of fishing efforts, and the legal status of fishing operations and catches being landed were discussed and addressed between Thailand and Myanmar; and among Thailand, Malaysia and Indonesia, respectively, during the Third Sub-regional Consultative Workshop of the Northern Andaman Sea/Myeik Archipelago (16-17 November 2017, Bangkok, Thailand), and the Sub-regional Consultative Meeting on the Joint Fisheries Management around the Southern Andaman Sea (21-22 November 2017, Bangkok, Thailand). From these events, the countries expressed the desire to establish the sub-regional MCS network which should be linked with the existing national networks for the Northern Andaman Sea and Southern Andaman Sea sub-regions.



Sub-regional Consultative Meeting on the Joint Fisheries Management around the Southern Andaman Sea

- **Monitoring of fishing efforts through enhanced traceability of fish and fishery products**

An important aspect in the traceability systems for fish and fishery products is to be able to verify where the fish have been caught and strengthen the monitoring of fishing efforts. In order to enhance the traceability system for fish and fishery products in the Southeast Asian region, SEAFDEC developed the ASEAN Catch Documentation Scheme (ACDS) which was endorsed during the 48th Meeting of the SEAFDEC Council in 2016 including the proposal to pilot test the ACDS in Brunei Darussalam. The pilot testing of ACDS was subsequently launched at the 49th Meeting of SEAFDEC Council in April 2017 in Brunei Darussalam in collaboration with SEAFDEC-Sweden Project, which also supported the development of an electronic system of the ACDS or eACDS. The Project also supported the conduct of “Stakeholders Meeting on Enhancing the Traceability of Blue Swimming Crab Fisheries in Trat Province through the Implementation of Simplified eACDS” on 7-9 December 2017 in Trat Province, Thailand.



Joint Workshop on Transboundary Fisheries Management on the Mekong and Sekong Rivers in Cambodia and Lao PDR (24 August 2017 in Pakse, Champasak, Lao PDR)



Technical Meeting of the Joint Working Team for Fisheries Management between Cambodia and Viet Nam

- **Awareness raising on the national laws and regulations**

Compilation of the information on fisheries laws and regulations of Cambodia, Lao PDR and Viet Nam, and implementation of the respective comparative studies, which was supported by the SEAFDEC-Sweden Project, was completed in December 2016. Findings of the studies were shared during the “Joint Workshop on Transboundary Fisheries Management on the Mekong and Sekong Rivers in Cambodia and Lao PDR,” which was hosted by Mekong River Commission (MRC) under the Mekong Integrated Water Resources Management Project (M-IWRMP) on 24 August 2017 in Pakse, Champasak, Lao PDR, as well as during the “Second Technical Meeting of the Joint Working Team for Fisheries Management between Cambodia and Viet Nam,” organized on 16-17 October 2017 in Phnom Penh, Cambodia. The participants recognized the importance of the document as basis to define common approaches to improve fisheries management, and to create a better understanding of the laws and regulations applicable in the each of the two countries to protect endangered species and reduce illegal fishing practices.

Output Objective 3: Capacity built and policy development processes improved for the drafting and implementation of regional & sub-regional agreements

- **Promotion of sustainable small-scale fisheries and FAO-SSF Guidelines**

Since the adoption of the “FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines)” in 2014, several countries, regional organizations and civil societies organizations have been supporting the steps toward the implementation of the SSF Guidelines. The basic concepts of the SSF Guidelines emphasize on securing sustainable resource use and access rights to tenure and fishery resources, while building upon a human rights-based approach and working on gender equity among the fisherfolk.

At the regional context, the SEAFDEC-Sweden Project in cooperation with FAO and other partners continued the process of applying the regional approach through consultations and expert meetings. The “Experts Workshop on Regional Approach for the Implementation



Experts Workshop on Regional Approach for the Implementation of FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries: Human Rights-based Approach and Gender-equitability

of the FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries: Human Rights-based Approach and Gender-equitability” was organized on 26-28 September 2017 in Bangkok, Thailand, and came up with the Policy Brief that serves as reference to increase understanding and awareness of the principles contained in the SSF Guidelines. The Policy Brief indicated the benefits and implications to the region based on the “human-rights based approach” and “gender equality and equity” in small-scale fisheries.

- **Enhancing coordination with AMSs through the Regional Fisheries Policy Network (RFPN) Program**

The program on the Regional Fisheries Policy Network (RFPN) has been on-going since 2006 and has supported the secondment of representatives from the AMSs States at the SEAFDEC Secretariat for a period of one year. In 2017, the seven members of the RFPN comprised the fisheries officers from Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam, four of whom were supported by the SEAFDEC-Sweden Project, and three by the Japanese Trust Fund (JTF). The RFPN members have been playing active roles in enhancing the coordination and communication between SEAFDEC and their respective countries, while also given the opportunity to attend and provide technical contributions in various events organized by SEAFDEC. The RFPN members also supported the efforts of SEAFDEC in developing strategies to promote fisheries policy dialogues, promote regional and sub-regional cooperation among the Member Countries, and follow-up the countries’ commitments for the implementation of



From left to right: 2017 RFPN Members from Thailand, Lao PDR, Philippines, Myanmar, Malaysia, Viet Nam, and Indonesia

policies under the ASEAN Framework. With the insights of regional policy development, the RFPN members are more comfortable in proactively supporting the development of regional and international cooperation arrangements. In addition, communications and sharing of information among the Member Countries have been enhanced through the Networking among RFPN Members that has been established for over a decade.

• Gender and social development

In 2017, the SEAFDEC-Sweden Project continued to support the activities of SEAFDEC towards building up gender awareness within SEAFDEC and in the region through the following ways and means:

- Conduct of an In-house Intensive Training Workshop on Gender Analysis (24-26 January 2017, Phetchaburi Province, Thailand)
- Conduct of an In-house Training on Gender Sensitivity for SEAFDEC Staff (4-5 April 2017 and 1 May 2017, Samut Prakan, Thailand), and 25 April 2017, Bangkok, Thailand)
- Conduct of the Workshop on Gender Awareness and Gender in Fisheries (for RFPN Members), 21 April 2017, Bangkok, Thailand)
- Participation in the Sweden Regional Workshop on Gender for Senior Management Level (23-24 March 2017, Bangkok, Thailand)
- Conduct of Regional Gender Study (10-21 October 2017, Trat Province, Thailand; and 26 November to 1 December 2017, Kep Province, Cambodia), in collaboration with Mangrove for the Future (MFF) and Stockholm Environment Institute (SEI)
- Conduct of the Workshop on Gender Analysis Using Toolkits for Data Collectors (17-23 September 2017, Trat Province, Thailand)

The SEAFDEC-Sweden Project also supported the establishment of the SEAFDEC Gender Team (Task Force) to play the key role in working on gender aspects in a more systematic manner, and promoting integration of gender concept within SEAFDEC. The services of a “Gender and Social Development Expert” is being availed of, to implement and conduct gender related activities and also to continue mentoring the SEAFDEC Gender Team.

The Project in collaboration with the IUCN/Mangroves for the Future (MFF) and Stockholm Environment Institute (SEI) also commenced in 2017, the 2-year “Regional Gender Study,” which aims to explore the gender patterns in coastal and marine resources management, and improve understanding of the state of women and men in environmental decision



*Data Collection on Gender Analysis
in Kep, Cambodia*



*Data Collection on Gender Analysis in Trat
Province, Thailand*

making and structural challenges preventing equitable opportunities for men and women in the coastal and marine areas, and the fisheries sector in Southeast and South Asia, as a whole.

- **Strengthening the sub-regional cooperation in target sub-regions – the Gulf of Thailand, Andaman Sea, Mekong River Basin, and Sulu-Sulawesi Seas**

The SEAFDEC-Sweden Project has been exerting efforts to support the AMSs in strengthening the regional cooperation to address transboundary issues and promote sub-regional cooperation on fisheries and habitat management, including measures to monitor and control fishing effort and landings across boundaries. The progress made under each sub-region in 2017, are summarized as follows:

- o ***Gulf of Thailand***

To continue the activities toward strengthening the Gulf of Thailand sub-regional cooperation, a series of bilateral consultations were subsequently conducted for neighboring countries, *i.e.* Thailand-Malaysia, Cambodia-Viet Nam, immediately after the “Sixth Meeting of the Gulf of Thailand Sub-region” on 28 February-2 March 2017 in Bangkok, Thailand. Through such consultations, the joint approaches for information sharing in support of the management of transboundary fish stocks, management of fishing capacity, monitoring of landings, MCS networks to combat illegal fishing, had been discussed, and the relevant issues addressed.

- o ***Andaman Sea***

Advancements had been made in the Andaman Sea sub-regional cooperation with the signing of the Memorandum of Understanding between Thailand and Myanmar to cooperate in several areas of mutual interest, including the management of transboundary stocks and combating IUU fishing. Moreover, through the Scientific Working Group organized under the RPOA-Neritic Tunas framework, information on the stock status and availability of neritic tunas in the Andaman Sea had been compiled. Such information could serve as a basis for the development of the neritic tuna management plan for the Andaman Sea in the future.

- o ***Mekong River Basin***

Cooperation with the Mekong River Commission (MRC) had been enhanced to support the relevant activities in the Mekong River Basin Sub-region. This was demonstrated through the endorsement of the MRC Basin-wide Fisheries Management and Development Strategy (BFMS) by the SEAFDEC-Sweden Project. In addition, signing of the Memorandum of Understanding between MRC and SEAFDEC was facilitated, to strengthen cooperation in areas of common interest and in support of a continued regular riparian inter-governmental monitoring of fisheries related matters. Moreover, the Project and MRC jointly hosted two regional events in 2017, namely: the “Regional Consultation on Formulation of Project Based Action Plan under the MRC Environment Management Division” and the “High Level Consultation on the Ecosystem Based Approach to Fisheries Management for Leaders,

Executives and Decision Makers (EAFM LEAD) in Lower Mekong Basin” on 19-20 December 2017 in Bangkok, Thailand.

o Sulu-Sulawesi Seas

Continued monitoring of the initiatives undertaken in the Sulu-Sulawesi Seas with support from the Coral Triangle Initiatives on Coral Reefs Fisheries and Food Security (CTI-CFF) and the USAID Oceans and Fisheries Partnership Project, was carried out. Specifically, discussions were regularly conducted between the Project and the USAID Oceans for continued updating of the progress on the planned activities.

• **Coordination with other organizations and projects**

Support of the joint activities and coordination with other SEAFDEC programs and projects, the ASEAN, and other international and regional organizations had been strengthened to enhance regional cooperation and ensure the long-term sustainability of marine and inland aquatic resources. This is in cognizance of the need to strengthen regional cooperation to build-up and promote a common understanding through joint regional, sub-regional and bilateral approaches, *i.e.* securing sustainability bearing in mind the “transboundary” nature of several fishery resources, including the mobility of fishers who pursue them. The SEAFDEC-Sweden Project also facilitated the recording of sub-regional initiatives during regional consultations and sub-regional events (Gulf of Thailand and Andaman Sea) as well as in the development of Regional Plans of Action, *e.g.* RPOA-Neritic Tunas and RPOA-Capacity.

Coordination with various partners had been enhanced, *e.g.* with the FAO Headquarters in Rome; FAO Regional Office for Asia and the Pacific (FAO/RAP) and the Asia-Pacific Fishery Commission (APFIC) in Bangkok; the Secretariat of the Regional Plan of Action to Promote Responsible Fishing Practices including Combating IUU Fishing (RPOA-IUU); and the Coral Triangle Initiative for Coral Reefs, Fisheries and Food Security (CTI-CFF). The Project also worked closely with the Mekong River Commission (MRC), and facilitated the signing of the MOU between SEAFDEC and MRC in June 2017. In addition, coordination and sharing of information had been strengthened with several organizations and projects such as SwAM, USAID Oceans, International Labour Organization (ILO), SEAFDEC/UNEP/GEF/Fisheries *Refugia* Project, and SEAFDEC/Japanese Trust Fund (JTF). Close collaboration with Mangroves for the Future (MFF)/IUCN on many aspects had been initiated, especially on transboundary areas management around the Gulf of Thailand and the Andaman Sea sub-regions, as well as on the newly established Regional Gender Study (2017 to 2018) among MFF, SEAFDEC and SEI.

On small-scale fisheries, coordination with FAO/Rome, FAO/RAP, Too Big to Ignore (TBTI) project, International Collective in Support of Fishworkers (ICSF), Kasetsart University and Burapha University of Thailand was strengthened. On the development of the “eACDS,” coordination was enhanced with the Fish Market Organization of Thailand, and on “labor aspects,” coordination with the International Labour Organization (ILO) and with a range of national partners, had been sustained.

In the Gulf of Thailand and Andaman Sea sub-regions, direct implementation of activities had been promoted under the SEAFDEC-Sweden Project. However, in the other two sub-regions (Mekong and the Sulu-Sulawesi Seas), the implementation of activities had been carried out mostly through collaboration with partners or by partners, the results of which were regularly monitored by SEAFDEC, *e.g.* MRC, CTI-CFF, USAID Oceans, among others.

- **Support to local capacity-building**

Considering that SEAFDEC as an intergovernmental body is not able to directly conduct activities at field level, the SEAFDEC-Sweden Project engaged and provided support to local partners working in the project areas to facilitate local capacity building, strengthen local organizations, support improved livelihood opportunities and poverty alleviation, and restore the important habitats. From 2014 to 2017, the Project provided support on local capacity building through the following local organizations:

- **Learning Institute (LI) of Cambodia**, working with communities and local administration in areas around Tonle Sap and coastal Cambodia, for the assessment of results of Cambodian fisheries reforms and rights-based fisheries
- **CORIN-Asia Cambodia**, working with communities and local administrations in Kampot, Kep and Sihanoukville in coastal Cambodia
- **CORIN-Asia Myanmar**, working with communities and local administrations in Kawthoung Province in southeast coastal Myanmar
- **Sustainable Development Foundation (SDF) of Thailand**, working with communities and local administrations in Trat Province, eastern part of the Gulf of Thailand bordering Koh Kong, Cambodia.

6.2 Oceans and Fisheries Partnership

The “**USAID Oceans and Fisheries Partnership**” or “USAID Oceans” for short, was launched in 2015 with the goal of strengthening regional cooperation for sustainable and legal management, and trade of natural resources in the Asia-Pacific region. Specifically, this Project aims to: 1) demonstrate a sustainable Catch Documentation and Traceability System (CDTS) and Fisheries Information System (FIS); 2) expand the use of CDTS/FIS to priority biodiversity areas; 3) strengthen the capacity of regional and national organizations to conserve biodiversity using the Ecosystem Approach to Fisheries Management (EAFM) and CDT; and 4) engage the private sector to ensure sustainability, while advancing regional fisheries governance. USAID Oceans has established two learning sites in General Santos City, Philippines and in Bitung, Indonesia to support the development, implementation, and testing of the CDTS and serve as a hub for regional knowledge sharing for replication and expansion.

The activities conducted under this project in 2017 include:

- “Gender Analysis Inception Workshop and Value Chain Mapping of Tuna Fisheries” from 9 to 12 January 2017 in General Santos, Philippines, which focused on the process of preparing for data collection, training for enumerator to collect data with quality, and introduce the Open Data Kit (ODK) application for data collection to reduce the data inputting steps

- “The USAID Oceans Integrated Stakeholders Consultation Workshop (ISCW)” organized from 19 to 21 June 2017 in Manado, Indonesia in close collaboration with the Fisheries Resources Directorate, Ministry of Maritime Affairs and Fisheries (MMAF), and University of Sam Ratulangi (UNSRAT) in Manado, Indonesia, and participated in by stakeholder groups from national and local fisheries-related government agencies, private sector, civil society organizations, and men and women fishers/groups who are engaged in the implementation of project activities in Bitung Site. The Workshop came up with a proposal for the development of the Sustainable Fisheries Management Plan (SFMP) through the Ecosystem Approach to Fisheries Management (EAFM).



Gender Analysis Inception Workshop and Value Chain Mapping of Tuna Fisheries



The USAID Oceans Integrated Stakeholders Consultation Workshop in Manado, Indonesia

- “Second Technical Working Group (TWG) Planning Workshop,” 12 to 14 July 2017 in Bangkok, Thailand, aimed at taking stock of the past year and discussing the activities for Fiscal Year 2017 (Program Year 3) with the involvement of TWG members from both learning sites in Philippines and Indonesia, including the expansion sites. Learning sessions were also conducted to share the approaches used in relation to fisheries appraisal, value chain analysis, development of Catch Documentation and Traceability System (CDT), and gender and labor analyses at the learning sites during the past year. The Workshop came up with the draft USAID Oceans Year 3 work plan aligned with country specific tasks and related work plans of partner organizations including work plan for the expansion sites.
- “Regional Gender Workshop: Gender Strategies Implementation in the Oceans and Fisheries Partnership Activity” from 21 to 22 August 2017 in Bangkok, Thailand, which was attended by USAID Oceans/TWG for Human Welfare of USAID Oceans from SEAFDEC Member Countries, SEAFDEC staff, USAID Oceans staff, and relevant partners, disseminated and discussed the results of the gender analysis on the fisheries sector at the learning sites at General Santos City, Philippines and Bitung, Indonesia. The Workshop also came up with a list of interventions to be provided grants under the USAID Oceans at the learning sites; proceedings with sections on gender analysis methodologies, results, gender gaps and indicators; and working draft of a regional document on gender mainstreaming in the fisheries work place.



Second Technical Group Planning Workshop



Regional Gender Workshop: Gender Strategies Implementation in the Oceans and Fisheries Partnership Activity

- “Regional Workshop on Fisheries Management Planning in Southeast Asia” from 23 to 25 August 2017 in Bangkok, Thailand, which was attended by USAID Oceans/TWG on EAFM and Human Welfare, SEAFDEC staff, USAID Oceans staff, relevant international organization and partners, was aimed at providing capacity building in fisheries management planning through the application of the concepts of Ecosystem Approach to Fisheries Management (EAFM) focusing on the Gulf of Thailand, Andaman Sea and Sulu-Sulawesi Sea areas.
- “Multi-Stakeholders Workshop on Fisheries Management Planning Process” from 29 to 30 August 2017 in Songkhla Province, Thailand, which was attended by fishers and fisheries stakeholders, USAID Oceans TWG member from Thailand, SEAFDEC staff, and USAID Oceans staff, and supported by the DOF of Thailand to initiate the crafting of the small pelagic fisheries management plan for Southern Thailand. The Workshop also enhanced the Catch Documentation and Traceability (CDT) System as an effective tool for combating IUU fishing and seafood fraud. Establishment of learning site profile of Songkhla Province together with identification of the issues and challenges of small pelagic fisheries in Southern Thailand were part of the output of the Workshop.



Regional Workshop on Fisheries Management Planning in Southeast Asia



Multi-Stakeholder Workshop on Fisheries Management Planning Process

SEAFDEC 50TH ANNIVERSARY AND ITS FUTURE DIRECTION BEYOND 2017

The Southeast Asian Fisheries Development Center (SEAFDEC) commemorated its 50th Anniversary on 15 November 2017 in Bangkok, Thailand with the Government of Thailand as the most gracious host. The Golden Jubilee Celebration depicted the feat and achievements of SEAFDEC during the past fifty years and its desires for the years beyond, in revolutionizing the development of sustainable fisheries in Southeast Asia.

The Golden Jubilee Celebration of SEAFDEC was officiated by *His Excellency Air Chief Marshal Prajin Juntong*, Deputy Prime Minister of the Kingdom of Thailand, on behalf of the Prime Minister *His Excellency Prayuth Chan-Ocha*. In attendance were the Ministers and representatives from Ministries responsible for fisheries of the 11 SEAFDEC Member Countries; the SEAFDEC Council of Directors and delegations led by the current Chairperson of the SEAFDEC Council *Mr. Abdul Halidi bin Mohd Salleh*; representatives from Embassies of the SEAFDEC Member Countries in Thailand; representatives from national, regional and international organizations working on fisheries and donor agencies; as well as guests



Arrival of the Guest of Honor H.E. Air Chief Marshal Dr. Prajin Juntong, accompanied by the Minister of Agriculture and Cooperatives H.E. General Chatchai Sarikulya (right), and the SEAFDEC Secretary-General Dr. Kom Silapajarn (left)



Mr. Abdul Halidi bin Mohd. Salleh, Chairperson of the SEAFDEC Council, delivering his Remarks during the Inaugural Ceremony of the Celebration



Mr. Kenji Kagawa, on behalf of Minister of Agriculture, Forestry and Fisheries of Japan expressing the willingness of Japan to cooperate for sustainable fisheries development of Southeast Asia



Dr. Deb Menasveta, the third SEAFDEC Secretary-General (1976 to 1981), delivering the Keynote Remarks delineating the past, present and future of SEAFDEC on the occasion of its fiftieth anniversary celebration

and distinguished personalities who made significant contributions to SEAFDEC. The SEAFDEC Secretary-General *Dr. Kom Silapajarn*, Deputy Secretary-General *Dr. Kaoru Ishii*, the Chiefs and senior officials of the SEAFDEC Secretariat and Departments also attended the Celebration.



From left to right: Mr. Abdul Halidi Mohd Salleh, Director, Fisheries Department of Brunei Darussalam and the current Chair of the SEAFDEC Council of Directors; H.E. Dr. Nao Thuok, the Secretary of State, Ministry of Agriculture, Forestry and Fisheries of Cambodia; H.E. Mr. Ahmad Rusdi, Ambassador Extraordinary and Plenipotentiary of the Republic of Indonesia to the Kingdom of Thailand; Mr. Kenji Kagawa, Special Advisor to the Minister of Agriculture, Forestry and Fisheries of Japan; H.E. Dr. Phouang Parisak Pravongviengkham, Deputy Minister of Agriculture and Forestry of Lao PDR; YH Dato' HJ Munir bin Mohd Nawi, Director-General, Department of Fisheries, Malaysia; H.E. Air Chief Marshal Dr. Prajin Juntong, Deputy Prime Minister of the Kingdom of Thailand; H.E. General Chatchai Sarikulya, Minister of Agriculture and Cooperatives of Thailand; Mr. Khin Maung Maw, Director-General, Department of Fisheries of Myanmar; Mr. Joselito Piñol, representative of the Secretary of the Department of Agriculture of the Philippines; Dr. Tan Lee Kim, Deputy Chief Executive Officer of the Agri-Food & Veterinary Authority of Singapore; Mr. Tran Dinh Luan, Deputy Director General, Directorate of Fisheries of Viet Nam; and Dr. Kom Silapajarn, SEAFDEC Secretary-General

Launched during the Anniversary event was the Anniversary Book “A Half-century Journey of SEAFDEC: Significantly Revolutionizing Southeast Asian Fisheries Towards Sustainability,” the copies of which were distributed to all the guests. The 50th Anniversary of SEAFDEC therefore displays not only the past achievements, but also the future unwavering commitment of SEAFDEC and all Members in working together to ensure that the fisheries sector would continue to provide sustainable contribution to food security and well-being of the peoples in the Southeast Asian region.



The Golden Jubilee Celebration of SEAFDEC started with the Special Meeting of the SEAFDEC Council in the morning of 15 November 2017 which adopted the “**Resolution on the Future of SEAFDEC,**” including the “**Vision, Mission, and Strategies Towards 2030.**” The said Resolution spells out the necessary actions that SEAFDEC would undertake beyond its Fiftieth Anniversary, for the sustainability of the Southeast Asian fisheries.



Resolution on the Future of SEAFDEC: Vision, Missions, and Strategies Towards 2030

We, the Council Directors of SEAFDEC during our Meeting in Bangkok, Thailand on the occasion of the Special Meeting of the SEAFDEC Council on 15 November 2017 organized in conjunction with the 50th Anniversary of SEAFDEC,

Recognizing that provisions in various international instruments such as the United Nations Convention on the Law of the Sea (UNCLOS, 1982), the UN Sustainable Development Goals (SDG, 2015), the FAO Code of Conduct for Responsible Fisheries (CCRF, 1995), and relevant International Plans of Action are crucial for the development of programs and activities towards enhancing the practices for sustainable fisheries development in the Southeast Asian region;

Affirming the need to implement actions in line with regional fisheries policy frameworks, particularly the Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region adopted by the ASEAN-SEAFDEC Ministers and Senior Officials responsible for fisheries during the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020 “Fish for the People 2020: Adaptation to a Changing Environment” in June 2011;

Also affirming the need to support the Member Countries of SEAFDEC in the implementation of regional guidelines and policy recommendations developed by the SEAFDEC in collaboration with the Member Countries;

Bearing in mind the need to enhance cooperation with ASEAN under the ASEAN-SEAFDEC Strategic Partnership (ASSP) framework, support the implementation of activities under the ASEAN-SEAFDEC Fisheries Consultative Group (FCG) mechanism, and take into consideration the “Strategic Plan of Action on ASEAN Cooperation in Fisheries (2016-2020)”; and

Recognizing the need for SEAFDEC to continue playing an active role in enhancing the collaboration among the Member Countries, as well as partnerships with prominent regional, international organizations and donor agencies towards the sustainability of fisheries and aquaculture in the Southeast Asian region;

Being aware the fact that regional guidelines and policy recommendations and frameworks developed under different organizations, mechanism and arrangements beyond Southeast Asian region need to be taken into account; and

Resolved to adopt the Vision, Missions, and Strategies of SEAFDEC towards 2030, as follows:

I. VISION

“Sustainable management and development of fisheries and aquaculture to contribute to food security, poverty alleviation and livelihood of people in the Southeast Asian region”

II. MISSIONS

“To promote and facilitate concerted actions among the Member Countries to ensure the sustainability of fisheries and aquaculture in Southeast Asia” through:

- i. **Research and development** in fisheries, aquaculture, post-harvest, processing, and marketing of fish and fisheries products, socio-economy and ecosystem to provide reliable scientific data and information.
- ii. **Formulation and provision of policy guidelines** based on the available scientific data and information, local knowledge, regional consultations and prevailing international measures.
- iii. **Technology transfer and capacity building** to enhance the capacity of Member Countries in the application of technologies, and implementation of fisheries policies and management tools for the sustainable utilization of fishery resources and aquaculture.
- iv. **Monitoring and evaluation** of the implementation of the regional fisheries policies and management frameworks adopted under the ASEAN-SEAFDEC collaborative mechanism, and the emerging international fisheries-related issues including their impacts on fisheries, food security and socio-economics of the region.

III. STRATEGIES

1) **Securing the sustainability of fisheries to contribute to food security, poverty alleviation and livelihood of people in the region:**

- a. Assessment of important marine fish stocks in the region and development of guidelines of management measures for such fish stocks;
- b. Assessment of the status of inland fisheries, and compilation of baseline information on policies and regulations related to inland fisheries in the Member Countries;
- c. Compilation of scientific data and information including local knowledge on both inland and marine fisheries to support policy formulation and management for sustainable fisheries;
- d. Development and promotion of regional measures and tools for combating IUU fishing;
- e. Development of innovative management tools and concepts that are applicable for fisheries in the region;
- f. Development and promotion of responsible fishing technologies, including energy optimization, carbon reduction and reduction of post-harvest losses onboard fishing vessels; and
- g. Integration of habitat and fisheries management, and provision of support for the conservation of important fishery resources.

2) Supporting the sustainable growth of aquaculture to complement fisheries and contribute to food security, poverty alleviation and livelihood of people in the region:

- a. Development, verification and promotion of responsible and sustainable aquaculture technologies, to improve the quality of broodstocks and technologies on seeds production;
- b. Finding alternatives to fishmeal in feed formulation and promote economical use of feeds;
- c. Development of practical fish health management strategies including the establishment of early warning system for aquatic animal diseases;
- d. Generation of appropriate technologies for rural aquaculture to provide livelihood and alleviate poverty; and
- e. Compilation of scientific data and information including local knowledge to support policy on sustainable aquaculture.

3) Ensuring the food safety and quality of fish and fishery products for the Southeast Asian region:

- a. Development and promotion of technology to produce high quality, healthy and safe fish and fishery products to meet the international standards;
- b. Improving endogenous processing technologies to standard or acceptable levels;
- c. Regular monitoring of chemical and biological contaminants to ensure seafood safety; and
- d. Promotion of seafood quality assurance systems for fish processing establishments in the region.

4) Enhancing trade and compliance of the region's fish and fishery products with market requirements:

- a. Strengthening the cooperation among Member Countries to implement international standards in trade of fish and fishery products within the ASEAN region;
- b. Development of regional standards, policies and guidelines to enhance intra-regional/international trade; and
- c. Development and promotion of traceability system for fish and fishery products in the region.

5) Addressing cross-cutting issues, such as labor, gender and climate change, where related to international fisheries:

- a. Provision of platforms for monitoring and evaluating the impacts of emerging international fisheries-related issues on the fisheries and economic sectors in the region;
- b. Organizing fora to enhance the awareness of Member Countries on international fisheries-related issues and coordinating the development of the ASEAN Common Positions to address the regional concerns on the issues;

- c. Monitoring of the possible impacts of and raising awareness on climate change to fisheries and aquaculture, and development of adaptation and mitigation measures in response to such impacts;
- d. Development regional initiatives to promote the consideration of environmental and biodiversity conservation issues in fisheries and aquaculture management; and
- e. Recognition of the importance of small-scale fisheries, welfare of labor in fisheries, safety at sea, and gender equality in the fisheries and aquaculture sector.

6) Empowering SEAFDEC to strengthen its roles in the region and to improve its services to Member Countries:

- a. Strengthening SEAFDEC's capacity to support ASEAN's efforts to adopt and implement regional policies and guidelines, as well as ASEAN's efforts to monitor the implementation of such regional policies and guidelines;
- b. Enhancing the human resource capability of the Member Countries to support, adopt and nationalize regional policies and guidelines;
- c. Expanding the network with prominent organizations in relevant fields and engaging actively in international fisheries fora;
- d. Enhancing human resources within SEAFDEC organization and pooling expertise in the region to improve the performance of SEAFDEC; and
- e. Promoting SEAFDEC to wider international communities to gain more supports from organizations, governments and donors.

SEAFDEC PROGRAMS FOR 2018

As scrutinized and endorsed during the 40th Meeting of the SEAFDEC Program Committee in 2017, the programs/projects that would be implemented in 2018 are shown below:

Program Category/Project Title	Responsible Department	Funding Source
ASEAN-SEAFDEC FCG/ASSP Programs		
Thrust I: Developing and Promoting Responsible Fisheries for Poverty Alleviation and Food Security		
1. Human Resource Development for Sustainable Fisheries	TD	JTF
2. Optimizing Energy Use/Improving Safety 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
7. Enhancing Sustainable Utilization and Management scheme of Tropical Anguillid Eel Resources in Southeast Asia	SEC	JAIF
Thrust II: Enhancing Capacity and Competitiveness to Facilitate International and Intra-regional Trade		
8. 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
9. Cold Chain Management for Seafood	MFRD	Singapore
10. Reinforcement and Optimization of Fish Health Management and the Effective Dissemination in the Southeast Asian Region	AQD	JTF
Thrust III: Improving Management Concepts and Approaches for Sustainable Fisheries		
11. Promotion of Countermeasures to Reduce IUU Fishing Activities	TD	JTF
12. Combating IUU Fishing in the Southeast Asian Region through Application of Catch Certification for International Trading in Fish and Fishery Products	MFRDMD	JTF
13. Establishment and Operation of a Regional System of Fisheries <i>Refugia</i> in the South China Sea and Gulf of Thailand	TD	UNEP/GEF

Program Category/Project Title	Responsible Department	Funding Source
Thrust IV: Providing Policy and Advisory Services for Planning and Executing Management of Fisheries		
14. Fisheries Resource Survey and Operational Plan for M.V. SEAFDEC 2	TD	JTF
15. Offshore Fisheries Resources Exploration in Southeast Asia	TD	JTF
16. Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region	TD/SEC	JTF
17. Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region	MFRDMD	JTF
18. Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region	MFRDMD	JTF
Thrust V: Addressing International Fisheries-related Issues from a Regional Perspective		
19. Assistance of Capacity Building in the Region to Address International Trade-related Issues	SEC	JTF
20. Strengthening SEAFDEC Network for Sustainable Fisheries	SEC	JTF
Special Projects		
21. Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia	SEC	Sweden
22. USAID-SEAFDEC "Oceans and Fisheries Partnership"	TD	USAID
Departmental Programs*		
1. Quality Seed for Sustainable Aquaculture	AQD	AQD
2. Healthy and Wholesome Aquaculture	AQD	AQD
3. Maintaining Environmental Integrity through Responsible Aquaculture	AQD	AQD
4. Adapting to Climate Change Impacts	AQD	AQD
5. Meeting Social and Economic Challenges in Aquaculture	AQD	AQD
6. Promotion on Strengthening of SEAFDEC Visibility and Image	TD	TD
7. Tailor-made Training Programs	TD	TD
8. Improvement of Fisheries Technology and Reduction of the Impact from Fishing	TD	TD

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



There was also two **pipeline projects** of which the proposals are prepared in consultation with respective donor agencies and the Member Countries:

Program/Project Title	Responsible Department	Funding Source
1. Strengthening the Effective Management Scheme with GIS (Geographic Information System) and RS (Remote Sensing) Technology for Inland Fisheries and Aquaculture at AMSs **	TD	JAIF
2. SEAFDEC-EU/CITES Sharks Project Phase II**	SEC	EU-CITES

** This project would be implemented under the FCG/ASSP mechanism once funding could be secured.

COOPERATION WITH DONORS AND OTHER ORGANIZATIONS IN 2017

Collaboration with International/Regional Organizations, Non-member Governments and Donors

- **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 (AMSs). In 2017, twenty-three (23) projects were implemented by SEAFDEC under the FCG/ASSP Mechanism. The progress and achievements in the implementation of these projects were reported to the 20th Meeting of the FCG/ASSP organized on 30 November to 1 December 2017 in Bangkok, Thailand.

With funding support from the Japan-ASEAN Integration Fund (JAIF), SEAFDEC implemented the project “Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia.” Proposals for the implementation of the project “Strengthening the Effective Management Scheme with GIS (Geographic Information System) and RS (Remote Sensing) Technology for Inland Fisheries and Aquaculture at AMSs” and for the conduct of the “ASEAN Regional Technical Consultation on Aquatic Emergency Preparedness and Response Systems for Effective Management of Transboundary Disease Outbreaks in Southeast Asia,” are undergoing negotiation with the JAIF for possible funding.

SEAFDEC also continued to support the 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, and the “Joint Declaration on Regional Cooperation for Combating IUU Fishing and Enhancing the Competitiveness of ASEAN Fish and Fishery Products” adopted in 2016. In addition, activities were implemented to support the AMSs in the implementation of regional guidelines and policy recommendations developed by SEAFDEC and endorsed by the ASEAN. In 2017, the ASEAN Sectoral Working Group on Fisheries (ASWGFi) at its 25th Meeting on 17-19 May 2017 in Singapore adopted the ASEAN Catch Documentation Scheme for Marine Capture Fisheries Concept (ACDS Concept) which was subsequently adopted by the SSOM-38th AMAF and the 39th AMAF Meeting.

SEAFDEC also participated in the events organized under the ASEAN framework, namely: the 9th Meeting of the ASEAN Fisheries Consultative Forum (AFCF) on 15-16 May 2017 in Singapore; the 25th Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGFi) on 17-19 May 2017 in Singapore; and the 4th ASEAN-EU High Level Dialogue on Maritime Security on 5-6 October 2017 in Manila, Philippines.

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

SEAFDEC signed the Letter of Agreement with the Australian Centre for International Agricultural Research (ACIAR) on 14 May 2015, for the implementation of the activity “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. Aimed 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, the activity was first extended for completion in March 2017, and extended again until December 2017.

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

SEAFDEC continued to be involved in regional and international events organized by FAO in 2017, namely: the 1st Meeting of the Parties to the 2009 FAO Agreement on Port State Measures (29-31 May 2017, Oslo, Norway); Coordinating Working Party on Fishery Statistics (CWP) Intersessional Meeting Aquaculture and Fisheries Subject Group (19-21 June 2017, Copenhagen, Denmark); Expert Workshop: Towards a review of the ‘Hidden Harvest’ (27-29 June 2017, Rome, Italy); Regional Advocacy Event for Monitoring the SDGs related to Food and Agriculture Sector (4-6 September 2017, Bangkok, Thailand); 16th Session of the FAO Sub-Committee on Fish Trade (4-8 September 2017, Busan, Republic of Korea); Expert Workshop on Securing Sustainable Small-Scale Fisheries: Towards monitoring the progress of applying the SSF Guidelines (5-7 September 2017, Bellagio, Italy); and the APFIC/FAO Regional Consultation “Building Climate Resilient Fisheries and Aquaculture in the Asia-Pacific Region” (14-16 November 2017, Bangkok, Thailand).

FAO also continued to support several activities of SEAFDEC in 2017, particularly the activity “Energy Audit for Trawlers in the Gulf of Thailand.” Moreover, FAO signed the Letter of Agreement (LoA) with SEAFDEC on 13 January 2017 for the execution of the project “Strategy for trawl fisheries bycatch management” or REBYC-II CTI. This LoA aims to enable SEAFDEC to carry out the remaining activities under the REBYC-II project, particularly the: 1) training on methods of energy audits and increasing fuel efficiency in fishing vessel operations; 2) EAFM training for provisional officers in Trat Province, Thailand; and 3) maintenance of the REBYC-II CTI website until the end of 2018.

FAO also signed another LoA with SEAFDEC/IFRDMD on 21 December 2017, to provide technical services for the “Regional Awareness Raising on Prospective Species Proposals to CITES COP18 and Preparation of Fisheries Related Information to Support Review of Species Proposals Against CITES Listing Criteria.” Under this LoA and upon decision on the most likely candidate species proposed for listing in the CITES Appendices during the CITES-CoP18, IFRDMD will organize a workshop in 2018, where FAO would provide information on the implications of such proposals on the sustainability of the fisheries in the region. Such workshop would also require the countries to prepare and provide fisheries information for species assessment by the FAO Expert Advisory Panel, the results of which could be used to support the possible amendments of the said proposals to CITES.

- **Government of Sweden**

The Government of Sweden continued its cooperation with SEAFDEC by providing funding support for the 5-year project “Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia” since 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 the 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. In 2016, the Government of Sweden agreed to extend the duration of this project, originally scheduled to be completed in 2017 for another two years until 2019.

- **International Union for Conservation of Nature and Natural Resources (IUCN)**

SEAFDEC signed a Letter of Agreement (LoA) with the International Union for Conservation of Nature and Natural Resources (IUCN) on 19 June 2017 to enable SEAFDEC to undertake the Regional Gender Study with the objective of pooling together information on the roles of men and women, as well as gender inequalities in coastal resource management and fisheries sector, local employment opportunities, and women’s engagement in environment decision making. Effective from the date of signing until 31 December 2017, the LoA allowed the SEAFDEC-Sweden Project and IUCN/Mangrove for the Future (MFF) Project to jointly support the said Regional Gender Study, undertaken by the Stock Environmental Institute (SEI).

- **INVE Asia Limited, China**

SEAFDEC/AQD signed the Memorandum of Agreement (MOA) with INVE Asia Limited on 24 January 2017 for AQD to carry out the activity on determining the effects of the application of probiotics and disinfectants to prevent and control infectious diseases, especially AHPND and luminescent vibriosis in *Penaeus vannamei*. Under this MOA, INVE Asia Limited would provide funds for the project, while AQD would provide the human resource expertise, technical assistance and qualified staff to carry out the said activity.

- **Islamic Development Bank (IDB)**

Under the Technical Assistance (TA) Agreement by IDB and SEAFDEC in 2016, SEAFDEC received funding support from the Islamic Development Bank (IDB) to undertake the project “Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management” with target beneficiaries that focused on the Muslim communities in the region’s coastal areas in three countries, namely: Brunei Darussalam, Malaysia, and Indonesia. Implemented by SEAFDEC/MFRDMD, the project was originally scheduled to be completed in 2017, however, MFRDMD has been communicating with IDB to extend this project for another 6 months (until June 2018) to complete the implementation of the remaining activities that had been postponed due to technical problems.

- **Japan-ASEAN Integration Fund (JAIF)**

In July 2017, SEAFDEC received approval from the Japan-ASEAN Integration Fund (JAIF) for financial assistance to support the implementation of the two-year project “Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia” from August 2017 to July 2019. Aimed to strengthen the statistics data collection system and clarify the basic resource condition of tropical anguillid eels, the project also intends to improve the survival rate of juvenile eels cultured in the AMSs by improving the eel culture technologies.

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

The Government of Japan has provided SEAFDEC/TD through the Japan’s Grant Aid Scheme for Eligible Countries, the M.V. SEAFDEC 2 in 2004. After the vessel’s decade of services, JICA and SEAFDEC discussed in 2015 the possibility of restoring the functions of the M.V. SEAFDEC 2. Thus, SEAFDEC and JICA agreed in 2016 on the scope of work and schedule for restoration of the M.V. SEAFDEC 2, and the actual restoration was undertaken during the 2nd and 3rd quarters of 2017.

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

Under the Memorandum of Agreement between SEAFDEC/AQD and Japan International Research Center for Agricultural Sciences (JIRCAS) for 2016 until 2021, two projects are being undertaken by SEAFDEC/AQD. One is the Integrated Multi-trophic Aquaculture (IMTA) in Milkfish Mariculture, which specifically aims to improve the livelihood of the people as well as assessing the feasibility and environmental impact of the IMTA approach. The other project looks at the alternatives to fishmeal as a protein source in fish feed formulations.

- **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/IFRDMD. On 21 June 2017, SEAFDEC signed the Memorandum of Understanding (MOU) with the Mekong River Commission (MRC) for “the Promotion of Sustainable Development of Fisheries and Aquaculture in Lower Mekong Basin and Southeast Asia.” This general MOU takes into consideration the relevant functions of MRC and SEAFDEC, and focuses in strengthening cooperation in the aspects of: 1) monitoring, research & development; 2) human resource development; 3) consultancy; and 4) information management and networking. Under this MOU, MRC and SEAFDEC would work together on activities that are of mutual interest and beneficial to both Parties. Either Party shall therefore initiate proposals for activities related to key strategic priority areas or actions set out in the Basin-wide Fisheries Management and Development Strategy (BFMS), and set forth specific details for such activities through Letters of Agreement which shall become integral part of this MOU.

Under the framework of this MOU, the Letter of Agreement was subsequently signed on 7 December 2017 for MRC and SEAFDEC to co-host the Regional Consultation on Formulation of the First Draft Action Plan of the BFMS on 19 December 2017, back to back with the Regional Workshop on Ecosystem Approach to Fisheries Management (EAFM) for senior fisheries managers of the Member Countries on 20 December 2017.

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

Since 2016, SEAFDEC/AQD has established collaboration with the Network of Aquaculture Centres in Asia-Pacific (NACA) through the signing of the Memorandum of Understanding to facilitate exchange of information and conduct of collaborative activities between AQD, NACA and other NACA lead centres, with AQD as NACA's regional lead centre for the Philippines. While sustaining such collaboration, SEAFDEC also supported NACA in its activities through its participation in the 28th Meeting of NACA Governing Council on 24-28 April 2017 in Dhaka, Bangladesh.

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

Since 2016, SEAFDEC has served as implementing agency for the project "Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand" with 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.

On 29 December 2017, SEAFDEC and UNEP signed a Small Scale Funding Agreement (SSFA) for SEAFDEC to serve as executing partner of UNEP in developing a concept note on Fisheries Trawl with a view to submitting it to the Green Climate Fund (GCF) for potential funding and the development of a communications strategy and social media platform for the Implementation of the Strategic Action Programme for the South China Sea.

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

SEAFDEC has collaborated with the United States Agency for International Development (USAID) in 2015 for the implementation of the project "Oceans and Fisheries Partnership" or the "USAID Oceans" for short. Aimed to: 1) demonstrate a sustainable Catch Documentation and Traceability System (CDTS) and Fisheries Information System (FIS); 2) expand use of CDTS/FIS to priority biodiversity areas; 3) strengthen the capacity of regional and national organizations to conserve biodiversity using an Ecosystem Approach to Fisheries Management (EAFM) and CDT; and 4) engage the private sector to ensure sustainability, while advancing regional fisheries governance, the USAID Oceans has established in 2017 two learning sites in General Santos City, Philippines and Bitung, Indonesia.

- **United States Department of Interior (US-DOI)**

On 31 March 2017, SEAFDEC signed a Memorandum of Understanding (MOU) with the United States Department of Interior (US-DOI) for “Advancing the Development and Implementation of a Fisheries Catch Documentation and Traceability System in Southeast Asia.” Mainly aimed to supplement the “Oceans and Fisheries Partnership,” the MOU has the specific objectives of: 1) developing a catch documentation and traceability (CDT) system and build capacity for its implementation; 2) implementing the Ecosystem Approach to Fisheries Management (EAFM); 3) integrating fair labor and gender equity considerations; 4) providing technical and capacity building support to expansion sites of the “Oceans and Fisheries Partnership”; and 5) providing administrative and coordination support for the technical objectives 1-4 above.

Collaboration with National Agencies of SEAFDEC Member Countries

- **Fisheries Research and Education 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 valid for the period of five years, has provided the framework for cooperation between SEAFDEC and FRA on: 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 2017, FRA dispatched experts to SEAFDEC, namely: *Dr. Kenji Taki* to serve as Deputy Chief of MFRDMD starting from April 2017; and *Dr. Takuro Shibuno* to serve as Deputy Chief of IFRDMD starting 15 January 2018.

- **Gifu Prefecture, Japan**

SEAFDEC and the Gifu Prefecture of Japan established a 5-year Memorandum of Understanding (MOU) in 2016 with the aim of promoting educational and technical cooperation for the sustainable development of inland fisheries in the Southeast Asian region. Specifically, the MOU would facilitate sending of trainees from the Southeast Asian region to the Gifu Prefecture Inland Fisheries Training Center in Japan. In 2017, under the framework of this MOU, Gifu Prefecture supported the participation of fishery officers from Indonesia (from IFRDMD), Malaysia, Philippines and Thailand to attend the “Inland Fisheries Training Program” on 29 August - 7 September 2017. This training had enhanced the knowledge and capacity of the fisheries officers from SEAFDEC Member Countries on the techniques in fishing and breeding of the sweetfish “*ayu*” (*Plecoglossus altivelis*).

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

SEAFDEC had established collaboration with the National Fisheries University (NFU) through the Arrangement for Academic and Educational Cooperation for the conduct of research and training cruise using the NFU training vessel “*Koyo Maru*” in the waters of SEAFDEC Member Countries. In 2017, the NFU proposed to carry out a joint research and training cruise using the *Koyo Maru* in waters under national jurisdiction of Viet Nam with port of

call at TD. However, the proposed research and training cruise in 2017 was cancelled, and rescheduled for 2018.

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

SEAFDEC/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 “Coastal Area Capability Enhancement in Southeast Asia” from 1 April 2012 to 31 March 2017. Aimed to create new development concept on “Area Capability” that can demonstrate how the ecosystem health could be harmonized with people’s welfare, the project had a component that was conducted in Rayong Province, Thailand in collaboration with TD.

- **San Joaquin School of Fisheries (SJSF), Philippines**

SEAFDEC/AQD signed a Memorandum of Agreement (MOA) with the San Joaquin School of Fisheries (SJSF) on 15 December 2017 to formalize a Work Immersion Program that will last until April 2018. Under the MOA, 12 students of the school were assigned at AQD’s FishWorld for their on-the-job training program in 2017.

- **Aklan State University (ASU), Philippines**

SEAFDEC/AQD signed a Memorandum of Agreement (MOA) with Aklan State University (ASU) on 19 April 2017 for On-the-Job Training of BS Fisheries students of ASU. Under the MOA, fifteen students had their on-the-job-training at AQD’s Marine Fish Hatchery in 2017.

- **Central Philippine University (CPU), Philippines**

SEAFDEC/AQD signed a Memorandum of Agreement (MOA) with Central Philippine University (CPU) on 3 April 2017 for the on-the-job training of nineteen BS Chemistry and BS Biology students of CPU through their participation in the implementation of relevant activities conducted by AQD.

- **West Visayas State University (WVSU), Philippines**

SEAFDEC/AQD signed a Memorandum of Agreement (MOA) with West Visayas State University (WVSU) for AQD to organize on-the-job training to students from WVSU as well as post-training evaluation. Under the MOA’s two-year effectivity (November 2017-February 2019), five BS Biology students from WVSU took part in the AQD on-the-job training program in 2017.

- **Aquascapes, Philippines**

SEAFDEC/AQD signed a Memorandum of Agreement (MOA) on 26 August 2017 with Lolita Uy Proprietor of Aquascapes, a private company involved in soft-shell crab production in the Philippines. Under the MOA on the commercialization of soft-shell crab production, which would last until 27 August 2018, AQD would provide technical assistance for the nursery

and grow-out operations of hatchery-reared mangrove crabs for soft-shell production, while Aquascapes would provide the skilled manpower, facilities and equipment for the operations.

- **Province of Southern Leyte, Philippines**

SEAFDEC/AQD signed a Memorandum of Agreement (MOA) with the Province of Southern Leyte in July 2017 to initiate internship training of its technical staff for the establishment of a high-value marine fish hatchery with emphasis on grouper and sea bass seed production. Under the MOA, the Province of Southern Leyte would defray the expenses for the conduct of the internship training for their selected technical staff. Two government staff from Province of Southern Leyte have so far attended AQD's training course on marine fish hatchery in 2017.

- **John B. Lacson Foundation Maritime University (JBLFMU), Philippines**

SEAFDEC/AQD signed a 5-year Agreement with John B. Lacson Foundation Maritime University (JBLFMU) on 1 February 2017. Under this Agreement, the JBLFMU would review and fund project proposals while AQD will supervise and assist in the conduct of researches by JBLFMU faculty, staff and students.

- **Protected Area Management Board for the Sagay Marine Reserve (PAMB-SMR), Philippines**

Under the Agreement between SEAFDEC/AQD and the Protected Area Management Board for the Sagay Marine Reserve (PAMB-SMR) which was signed in March 2015, the promotion of community-based production and resource enhancement was continued in Sagay City. Conducted by AQD researchers with active participation of local fisherfolks, the research studies focused on 4 identified threatened species, such as abalone, sandfish and seahorse, and the giant clam which had already been completed. The agreement will be in force until 9 March 2020.

- **Western Philippines University (WPU), Philippines**

Under the Agreement between SEAFDEC/AQD and the Western Philippines University (WPU) which was signed in January 2016, AQD would provide on-the-job training to students of the WPU as well as conduct an evaluation after their completion of the training. For 2017, five (5) students from WPU availed of the program.

- **Cosmic Technologies, Inc. (CTI), Brgy. Council of Pipindan (BCP), and Samahan ng mga Mag-uulang sa Pipindan (SMP), Philippines**

Under the Agreement signed between SEAFDEC/AQD and Cosmic Technologies, Inc. (CTI), Brgy. Council of Pipindan (BCP), and Samahan ng mga Mag-uulang sa Pipindan (SMP) on 18 November 2016, which aimed to jumpstart freshwater prawn farming in the community neighboring AQD's Binangonan Freshwater Station, hatchery facilities have been built beside the community hall of Brgy. Pipindan with funding support from CTI and some

improvised tanks donated by AQD. The hatchery is still non-operational pending availability of a stable electrical power supply and few other facilities.

- **Post-Harvest Technology Centre (PHTC), 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 39th Meeting in 2007. In 2016, the PHTC supported MFRD in enhancing the development of fisheries post-harvest technology in the Southeast Asian region through two on-going 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 which is supported by the Government of Singapore.

- **Fish Market Organization (FMO), Thailand**

Under the MOU signed between SEAFDEC and the Fish Market Organization (FMO) in 2016 for the development and promotion of electronic system of the ASEAN Catch Documentation Scheme (eACDS), SEAFDEC has been working with the FMO in 2017 for the development of web-based and mobile applications of the eACDS making use of the Marine Catch Purchasing Document (MCPD) developed and used by FMO for catches landed at ports as basis for such development. SEAFDEC also involved the staff of FMO in the relevant activities, especially in the pilot testing of the eACDS in Brunei Darussalam.

- **Vocational Education Commission, Thailand**

The re-extension of Memorandum of Understanding between SEAFDEC and Office of Vocational Education Commission on development of manpower for operation of fishing vessel signed on 10 November 2014, which was originally established under the “Memorandum of Understanding” signed in 2011, was facilitated. Under this MOU, TD conducted the a four-month training course on “Fishing Vessel Operations” from 10 October 2017 to 15 February 2018 for students from Tinsulanonda Fisheries College of Songkha Province. The training course was designed to cover six relevant subjects, namely: 1) construction and stability of fishing vessels; 2) marine communication; 3) laws and regulations of navigation; 4) navigation technology practices; 5) marine machinery technology and practices; and 6) fishing gear technology and practices.

ENHANCING SEAFDEC VISIBILITY IN 2017

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 2017, the progress and achievements made by SEAFDEC in the implementation of information activities were monitored and discussed during the 18th Meeting of the Information Staff Program (ISP) on 10-12 October 2017 in Singapore, 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

- Technical/scientific materials: 28 title/issues: 24,175 copies produced, 8,590 copies distributed
- Technical/scientific articles: 73 titles: 46 titles published in SEAFDEC publications and 27 titles published in non-SEAFDEC publications
- Inquiries for information through the SEAFDEC libraries recorded and replied: 3,163 queries recorded, 670 materials sold, and 943 citations

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

- Promotional materials: 40 titles/issues: 70,510 copies produced, 31,225 copies distributed
- SEAFDEC websites established and web blocks administered: SEAFDEC Departmental websites received a total of 94,813 unique visitors, 6,074 links from other websites, and recorded 74,309 annual downloads
- Participation in exhibitions and related events: joined fifteen (15) exhibitions with 29,093 visitors recorded at SEAFDEC exhibition booths and displays
- Official press statements released: twenty-five (25) press statements released, and recorded 87 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 SEAFDEC Secretariat and Departments: SEAFDEC Secretariat and Departments libraries continued to provide library services
- Additional acquisitions of SEAFDEC libraries: total of 883 issues of newsletters/serial publications, 488 titles of technical publications and 6 items of audio-visual materials were acquired
- Cooperation and exchange of materials: sustained cooperation with 481 network libraries within and outside the region

- Dissemination of technical and promotional materials: 104 titles (with 11,021 copies) of technical materials, and 62 titles (with 37,535 copies) of promotional materials disseminated to target groups
- Accessibility of information materials: 2,745 downloadable materials and 10 databases made accessible in SEAFDEC websites
- The Institutional Repository of SEAFDEC Secretariat and Departments were established and could enhance the accessibility of SEAFDE information
- Usage of e-mail systems (including e-groups) to facilitate communications both among SEAFDEC staffs and with other concerned personalities had been enhanced
- Direct visitors to SEAFDEC Secretariat and Departments: recorded a total number of 23,351 visitors
- Participation of SEAFDEC officials to events organized by other organizations: 407 SEAFDEC officials participated in 241 events: 87 officials in events at regional/international levels, and 154 at national local levels
- SEAFDEC events organized:
 - o International/regional meetings, seminars, workshops: 24 meetings with 1,184 participants
 - o National/local meeting, seminars, workshops, consultations: 17 meetings with 1,016 participants
 - o International/regional training courses: 16 courses with 187 trainees
 - o National, on-site training courses: 22 courses with 421 trainees
 - o Study tours: 1 programs with 30 trainees
 - o Internships: 2 groups with 35 interns
 - o On-the-job training: 8 colleges participated with a total of 258 students
 - o Internal meetings: 18 meetings with 439 participants
- Participation of officials from Member Countries in events organized by SEAFDEC facilitated:
 - o International/regional meetings, seminars, workshops (641 participants)
 - o National/local meetings, seminars, workshops, consultations (1,010 participants)
 - o International/regional training courses (987 trainees)
 - o National on-site training courses (514 trainees)
 - o Study tours (30 trainees)
 - o Internships (36 persons)
 - o On-the-Job training (259 students);
- Network and cooperation mechanisms established (now with 50 fisheries-related organizations) for the implementation of collaborative activities at national, regional and international levels
- Support from other organizations and donor agencies for relevant activities solicited: total support received in 2017: US\$ 2,805,897 representing non-regular sources of funds for the activities of SEAFDEC

Strategy 4: Strengthening SEAFDEC capability in information-related activities

- Capabilities of SEAFDEC staff in information-related offices enhanced (through HRD taking into account the scope and requirements of concerned staff, and during annual ISP Meetings)

- Financial sustainability of SEAFDEC institutional publications and information activities boosted (through intensified sale of technical publications and souvenir items on cost-recovery basis)

Strategy 5: Regular monitoring and evaluation of information activities

- Feedback on materials produced by SEAFDEC obtained (developed for the training, research, and information transfer through communication channels, *e.g.* dedicated e-mail, etc.)
- Eighteenth Meeting of the SEAFDEC Information Staff Program (ISP) organized to monitor the implementation of information-related activities, in accordance with the Information Strategies for Enhance SEAFDEC Visibility and Communication (convened on 10-12 October 2017 in Singapore)

Table 1. Participation of Member Countries in SEAFDEC Events in 2017

Category	Participants from Member Countries (persons)										
	Brunei Darussalam	Cambodia	Indonesia	Japan	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
SEAFDEC regional/international meetings, seminars, workshops	23	53	60	72	21	71	31	33	21	208	48
SEAFDEC national/local meetings, seminars, workshops, consultations	0	46	6	0	154	40	31	390	0	323	20
International/regional training courses	60	7	15	0	5	17	7	825	14	27	10
National, on-site training courses (course/trainees)	0	49	0	1	14	30	1	299	0	105	15
Study tours (no. of program/trainees)	0	0	0	0	4	0	0	26	0	0	0
Internships (group/persons)	0	0	0	1	0	1	0	34	0	0	0
On-the-job training (college/students)	0	0	0	0	0	0	0	237	0	19	3
SEAFDEC internal events	0	0	0	2	0	1	0	0	1	1	0
TOTAL	83	155	81	76	198	160	70	1,844	36	683	96

SEAFDEC REVENUES AND EXPENDITURES IN 2017

Un-Audited Abridged Consolidated Financial Statements-2017 (in US\$)

	2017 (Un-audited)	2016 (Audited)
REVENUES		
Contributions from:		
Member governments	9,581,412	9,536,811
Other sources	1,467,728	1,674,640
Total Revenues	11,049,140	11,211,451
EXPENDITURES		
Operating and Capital Expenditures		
Research	2,978,445	3,310,471
Training	1,132,949	661,064
Information	572,819	482,023
Collaborative	160,458	151,637
Others	495,366	440,755
Administrative	4,763,538	4,562,088
Total Expenditures	10,103,575	9,608,038
SURPLUS (DEFICIT), For the year	945,565	1,603,413
FUND BALANCE, Beginning of year	10,002,773 ^{1/}	7,704,897
FUND ADJUSTMENT	1,069	37,455
FUND BALANCE, End of year	10,949,407	9,345,765 ^{1/}
REPRESENTED BY:		
Cash and cash equivalents	11,427,403	9,084,651
Other receivables and Advances	318,276	754,072
Supplies Inventory	47,737	53,639
Fuel for vessels	264,823	97,782
Prepayments	33,318	15,931
Total Current assets	12,091,557	10,006,075
Reserved budget for vessel periodic maintenance	169,686	143,102
Termination indemnity fund	2,333,761	1,992,727
Long-term investments and Other noncurrent assets	534,135	384,134
Total Assets	15,129,139	12,526,038
Less: Liabilities		
Accrued payable	604,813	994,063
Contribution received in advance	982,920	86,412
Fund held in trust	258,238	107,071
Provision for termination indemnity	2,333,761	1,992,727
Total Liabilities	4,179,732	3,180,273
NET ASSETS	10,949,407	9,345,765

Remark: ^{1/} Difference of US\$ 657,008 is a result of change of rate in US\$ transactions.

Un-audited Contribution Received by SEAFDEC from Member Countries and Other Sources of Funds for the Year 2017 (In US\$)

Sources							Total	
	Secretariat	TD	MFRD	AQD	MFRDMD	IFRDMD	In US\$	%
Brunei Darussalam	7,000						7,000	0.06
Cambodia	12,000						12,000	0.11
Indonesia	52,000					858,725	910,725	8.24
Japan	280,000						280,000	2.54
Lao PDR	6,500						6,500	0.06
Malaysia	21,500				804,771		826,271	7.48
Myanmar	22,500						22,500	0.20
Philippines	25,000			4,406,169			4,431,169	40.10
Singapore	13,500						13,500	0.12
Thailand	33,000	3,012,747					3,045,747	27.57
Viet Nam	26,000						26,000	0.24
Sub-total	499,000	3,012,747	0	4,406,169	804,771	858,725	9,581,412	86.72
Other Sources ^{2/}	49,820	632,455		785,453			1,467,728	13.28
Total	548,820	3,645,202	0	5,191,622	804,771	858,725	11,049,140	100

Remark:

^{2/} 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 2017 (In US\$)

Sources	Amount in US\$ ^{3/}
UNEP/GEF	0.00
Fisheries Agency-Japan (TF-VI) (excluded: Japan-MRC=US\$280,000)	1,383,400
Sweden	848,845
Japan-ASEAN Integration Fund (JAIF)	589,997
Total	2,822,242

Remark:

^{3/} Other sources of contributions which are not reported in the SEAFDEC Financial Statements.



www.seafdec.org

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