

SEAFDEC

Annual Report

2018



Southeast Asian Fisheries Development Center

SEAFDEC Annual Report **2018**



Southeast Asian Fisheries Development Center

Preparation and Distribution of this Document

This SEAFDEC Annual Report 2018 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.

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EXECUTIVE SUMMARY

The SEAFDEC Annual Report 2018 summarizes the programs of activities undertaken by SEAFDEC throughout the year, 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 2018 had been categorized into: 1) Programs under the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) (24 projects); Departmental Programs (10 programs); and Other Programs (1 program). For the year 2018, SEAFDEC started to align its programs of activities with the “SEAFDEC Strategies Towards 2030” adopted by the SEAFDEC Council during its Special Meeting held in 2017 in conjunction with the 50th Anniversary of SEAFDEC. The six Strategies are: 1) Securing the sustainability of fisheries to contribute to food security, poverty alleviation and livelihood of people in the region; 2) Supporting the sustainable growth of aquaculture to complement fisheries and contribute to food security, poverty alleviation and livelihood of people in the region; 3) Ensuring the food safety and quality of fish and fishery products for the Southeast Asian region; 4) Enhancing trade and compliance of the region’s fish and fishery products with market requirements; 5) Addressing cross-cutting issues, such as labor, gender and climate change, related to international fisheries; and 6) Empowering SEAFDEC to strengthen its roles in the region and to improve its services for the Member Countries.

In 2018, SEAFDEC also continued to strengthen its cooperation and partnership with other international and regional organizations, national agencies of the Member Countries, as well as non-member governments that share common interest towards sustainable fisheries development, specifically tapping their expertise and relevant resources for the programs and activities implemented by SEAFDEC that aim to promote sustainable fisheries development in the Southeast Asian region. SEAFDEC also continued to organize regional consultations on wide range of subjects to gather inputs from the Member Countries with a view to ensuring that its programs properly address the common concerns of the countries. In 2018, SEAFDEC continued to take part in relevant international fora in order to monitor the development of global issues in fisheries, and ensure that regional situations are properly reflected at these fora. SEAFDEC also sustained its efforts in compiling the outputs from its programs and projects, and disseminating these to target audience with a view to providing maximum impacts from the works of SEAFDEC on the sustainable development of fisheries in the region.

It is therefore envisioned that this SEAFDEC Annual Report 2018 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 their respective countries as well as in the whole Southeast Asian region.

MESSAGE FROM THE CHAIRPERSON OF SEAFDEC COUNCIL



It has been a great honor for me to serve as Chairperson of the SEAFDEC Council for the year 2018-2019 and to witness the implementation of several SEAFDEC programs and projects in 2018 that are in line with the new SEAFDEC Strategies Towards 2030 adopted by the SEAFDEC Council in 2017. Such streamlining of SEAFDEC activities assures the Member Countries that their needs and requirements for sustainable fisheries are being addressed, *e.g.* securing the sustainability of fisheries to contribute to food security, poverty alleviation and livelihood of people; supporting the sustainable growth of aquaculture; ensuring the food safety and quality of fish and fishery products; enhancing trade and compliance of the region's fish and fishery products with market requirements; addressing cross-cutting issues, such as labor, gender and climate change, that are related to international fisheries; and empowering SEAFDEC to strengthen its roles in the region and improve its services to Member Countries

While the development and promotion of the implementation of several regional frameworks had been part of the on-going works of SEAFDEC, I would like to specifically commend the Center for convening meetings, particularly the regional consultation on international fisheries related issues that supports the development of common/coordinated views of the Member Countries to be reflected in relevant international fora. Such endeavors are very important in reflecting the regional concerns, and safeguarding the interest of the fisheries sector of the Southeast Asian countries in several aspects. Furthermore, on combating IUU fishing which is an important priority for several countries in the region, the initiatives of SEAFDEC formed the pieces of the puzzle toward the direction of addressing such concerns for the sustainability of the region's fisheries. Through the platform for regional coordination facilitated by SEAFDEC, several countries have made big progress towards combating IUU fishing. On behalf therefore of the SEAFDEC Council, I would like to extend our gratitude to SEAFDEC and wish that it will keep up its outstanding tasks in the future.

I am also happy to note that SEAFDEC has made significant progress in strengthening its cooperation and partnership with other international and regional organizations, national agencies of the Member Countries, as well as non-member governments that share common interest towards the sustainable development of fisheries. Many of these organizations have provided expertise, especially in regional consultations on wide range of subjects where the concerns of the Member Countries are compiled to ensure that these are properly addressed.

On the occasion therefore of the publication of this Annual Report that summarizes the activities and achievements of SEAFDEC in 2018, I would like to congratulate SEAFDEC for its efforts in supporting the Member Countries in their endeavors for sustainable fisheries development. I would also like to confirm the Member Countries' commitment to continue supporting SEAFDEC in its programs and projects in the years to come.

A handwritten signature in blue ink, appearing to read 'cheas', with a stylized flourish at the end.

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

MESSAGE FROM THE SEAFDEC SECRETARY-GENERAL



2018 is one of the very significant years of SEAFDEC that paved the way towards the 6th decade of the organization. The SEAFDEC Council adopted in 2017, the Resolution on the Future of SEAFDEC including the SEAFDEC Strategies Towards 2030. Subsequently, SEAFDEC started aligning its programs and activities in 2018, to ensure that these are in line with the Strategies as indicated in this Annual Report. Furthermore, several areas of works started to produce significant results. Through the years, the extensive capacity building extended by SEAFDEC to the Member Countries on the Ecosystem Approach to Fisheries Management (EAFM) provided better understanding of the EAFM concept and its application in several programs and projects towards sustainable development of fisheries and improved people's livelihood. SEAFDEC's works on the promotion of sub-regional and bi-lateral cooperation led to strengthened cooperation among countries on ranges of issues such as habitat and resources conservation, improved fisheries management, and combating IUU fishing. Several works on stock assessment of shared stocks, such as the longtail tuna, kawakawa, Indo-Pacific mackerels, king mackerels and Spanish mackerels had resulted in technical recommendations for sustainable utilization of the species. Besides its works on neritic tuna species, extensive works have also been initiated for several transboundary species of the region, such as sharks, anguillid eels, sardines, anchovies, blue swimming crabs, etc.

In this year, progress has also been made by SEAFDEC and the Member Countries on the application of several tools for combating IUU fishing. The ASEAN Catch Documentation Scheme was implemented through its electronic system or eACDS in Brunei Darussalam, and this would be expanded to other countries in due course with a view to enhancing the traceability of fish and fishery products from the region. Other initiatives were also pursued, e.g. training to promote the implementation of Port State Measures (PSM), use of the Regional Fishing Vessels Record (RFVR). The progress made by the countries in the implementation of various elements in the Regional Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain was also evaluated. Furthermore, several regional tools and guidelines have also been concluded by SEAFDEC, such as the Regional Guidelines on Cold Chain Management of Fish and Fishery Products in the ASEAN Region which was finalized for approval by the SEAFDEC Council, the Regional Database of Alternative Feed Ingredients in Aquaculture which was launched in July this year.

Although much progress has been attained by SEAFDEC, such success could not have been possible without the support of all the SEAFDEC Member Countries as well as the collaborating organizations that work towards the common goal of attaining the sustainable development of fisheries in the Southeast Asian region. I would therefore wish to take this opportunity to express my sincere gratitude to all the SEAFDEC Council Directors for providing guidance and support to the SEAFDEC Secretariat and Departments. I would also like to thank the donor agencies and partner organizations for working closely with SEAFDEC in the formulation and implementation of activities in 2018, and I truly wish that such collaborative atmosphere would be continued and strengthened in the future.

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
ASWGF	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
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization of the United Nations
FCG	ASEAN-SEAFDEC Fisheries Consultative Group
GEF	Global Environmental Facility
GIS	Geographic Information System
HABS	Harmful Algal Blooms
IDB	Islamic Development Bank
IFRDMD	SEAFDEC Inland Fishery Resources Development and Management Department
ILO	International Labour Organization
IOTC	Indian Ocean Tuna Commission
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
MSY	Maximum Sustainable Yield
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
RPOA	Regional Plan of Action

SDGs	Sustainable Development Goals
SEAFDEC	Southeast Asian Fisheries Development Center
SOM-AMAF	Senior Officials Meeting of the ASEAN Ministers on Agriculture and Forestry
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TD	SEAFDEC Training Department
UNEP	United Nations Environmental Programme
USAID	United States Agency for International Development
US-DOI	U.S. Department of Interior
WCPFC	Western and Central Pacific Fisheries Commission

CONTENTS

	Page
Executive Summary	
Message from the Chairperson of the SEAFDEC Council	
Message from the SEAFDEC Secretary-General	
List of Acronyms	
About SEAFDEC	1
SEAFDEC Council of Directors in 2018	3
SEAFDEC Senior Officials in 2018	6
Overview of SEAFDEC Programs in 2018	7
SEAFDEC Programs of Activities in 2018	12
1. Strategy I: Securing the sustainability of fisheries to contribute to food security, poverty alleviation and livelihood of people in the region	12
2. Strategy II: Supporting the sustainable growth of aquaculture to complement fisheries and contribute to food security, poverty alleviation and livelihood of people in the region	42
3. Strategy III: Ensuring the food safety and quality of fish and fishery products for the Southeast Asian region	75
4. Strategy IV: Enhancing trade and compliance of the region's fish and fishery products with market requirements	77
5. Strategy V: Addressing cross-cutting issues, such as labor, gender and climate change, where related to international fisheries	81
6. Strategy VI: Empowering SEAFDEC to strengthen its roles in the region and to improve its services to Member Countries	84
7. Special Projects	86
SEAFDEC Programs for 2019	100
Cooperation with Donors and Other Organizations in 2018	117
Enhancing SEAFDEC Visibility in 2018	126
SEAFDEC Revenues and Expenditures in 2018	129

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 and management, and conservation and management of aquatic species under international concern, *e.g.* sharks and marine turtles. MFRDMD also implements activities that support the Member Countries, especially in the compilation of information on small pelagic species, and establishment of indicators that could be used for the sustainable development and management of fisheries.



SEAFDEC/MFRDMD

The Inland Fishery Resources Development and Management Department (IFRDMD)

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 OF DIRECTORS IN 2018

Chairpersons of the SEAFDEC Council

Mr. Abdul Halidi Mohd. Salleh (*until March 2018*)

H.E. Eng Cheasan (*since March 2018*)

SEAFDEC Council and Alternate Council Directors

Brunei Darussalam

Council Director:	Mr. Abdul Halidi Mohd. Salleh (<i>until October 2018</i>) Director, Department of Fisheries
	Ms. Mariani Haji Sabtu (<i>since October 2018</i>) Acting Director of Fisheries, Department of Fisheries, Ministry of Primary Resources and Tourism
Alternate Council Director:	Ms. Mariani Haji Sabtu (<i>until October 2018</i>) Acting Deputy Director, Department of Fisheries
	Ms. Naraini Haji Anggas (<i>since October 2018</i>)

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 (<i>until January 2018</i>) Deputy Director-General, Fisheries Administration
	Mr. Buoy Roitana (<i>since January 2018</i>) Deputy Director-General, Fisheries Administration

Indonesia

Council Director:	Mr. Rifky Effendi Hardijanto Secretary General of Ministry of Marine Affairs and Fisheries
Alternate Council Director:	Dr. Achmad Poernomo (<i>until November 2018</i>) Advisor to Minister for Public Policy, Ministry of Marine Affairs and Fisheries

Japan

Council Director:	Mr. Shingo Ota Councillor, Resource Management Department, Fisheries Agency Ministry of Agriculture, Forestry and Fisheries
Alternate Council Director:	Ms. Yukiko Okano Director, First Country Assistance Planning Division, International Cooperation Bureau, 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 Dato' Hj Munir bin Hj Mohd Nawi**
Director-General of Fisheries Malaysia
- Alternate Council Director: **YBrs Mdm Tan Geik Hong**
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** (*until November 2018*)
Deputy Director-General, Department of Fisheries
Mr. Bunchong Chumnongsittathum (*since November 2018*)
Deputy Director-General, Department of Fisheries

Viet Nam

Council Director:

Dr. Tran Dinh Luan

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 2018

Secretary-General

Dr. Kom Silapajarn

Deputy Secretary-General

Mr. Tetsuya Kawashima (until April 2018)

Mr. Akito Sato (since May 2018)

Training Department (TD)

Chief

Dr. Kom Silapajarn

Deputy Chief

Mr. Tetsuya Kawashima (until April 2018)

Mr. Akito Sato (since May 2018)

Marine Fisheries Research Department (MFRD)

Chief, MFRD Programmes

Mr. Yeap Soon Eong (until July 2018)

Mrs. Khoo Gek Hoon (since July 2018)

Aquaculture Department (AQD)

Chief

Mr. Dan D. Baliao

Deputy Chief

Dr. Chihaya Nakayasu (until March 2018)

Dr. Koichiro Mori (since April 2018)

Marine Fishery Resources Development and Management Department (MFRDMD)

Chief

Mr. Raja Bidin Raja Hassan

Deputy Chief

Dr. Kenji Taki

Inland Fishery Resources Development and Management Department (IFRDMD)

Chief

Dr. Arif Wibowo

Deputy Chief

Dr. Takuro Shibuno

OVERVIEW OF SEAFDEC PROGRAMS IN 2018

The activities of SEAFDEC in 2018 were formulated and implemented in line with the policy directives given by the SEAFDEC Member Countries during SEAFDEC annual meetings, *i.e.* the 40th Meeting of the SEAFDEC Program Committee (27-29 November 2017, Bangkok, Thailand), 20th Meeting of the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) (30 November - 1 December 2017, Bangkok, Thailand), and the 50th Meeting of SEAFDEC Council (26-30 March 2018, Siem Reap, Cambodia).



SEAFDEC Council Directors attending the 50th Meeting of the Council hosted by the Government of the Kingdom of Cambodia

The formulation and development of the SEAFDEC programs and activities for 2018 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 and Senior Officials 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).” Nevertheless, under the SEAFDEC mechanism, the programs and projects, particularly those under the ASEAN-SEAFDEC Fisheries Consultative Group (FCG) were categorized based on the “SEAFDEC Strategies Towards 2030,” which was adopted by the SEAFDEC Council at its Special Meeting in 2017.

The progress of implementation of the programs and activities implemented by SEAFDEC in 2018 were considered and endorsed by the 41st SEAFDEC Program Committee Meeting held on from 5-7 November 2018 in Langkawi, Malaysia and the 21st Meeting of the FCG/ASSP on 8-9 November 2018 also in Langkawi, Malaysia for subsequent submission to the SEAFDEC Council at its 51st Meeting in 2019.



Participants of the 41st SEAFDEC Program Committee Meeting (above) and the discussion during the 21st Meeting of the FCG/ASSP (below)

The programs and projects implemented by SEAFDEC in 2018 are as follows:

1) Projects under the ASEAN-SEAFDEC FCG/ASSP Mechanism

Strategy/Project Title	Lead Department	Funding Source
Strategy I: Securing the sustainability of fisheries to contribute to food security, poverty alleviation and livelihood of people in the region		
1. Human Resource Development for Sustainable Fisheries	TD	JTF

Strategy/Project Title	Lead Department	Funding Source
2. Optimizing Energy Use/Improving Safety Onboard in Fishing Activities	TD	JTF
3. Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia	TD	JTF
4. Enhancement of Sustainability of Catadromous Eel Resources in Southeast Asia	IFRDMD	JTF
5. Promotion of Responsible Utilization of Inland Fisheries in Southeast Asia	IFRDMD	JTF
6. Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management	MFRDMD	IDB
7. Promotion of Countermeasures to Reduce IUU Fishing Activities	TD	JTF
8. Establishment and Operation of a Regional System of Fisheries <i>Refugia</i> in the South China Sea and Gulf of Thailand	TD	UNEP/GEF
9. Offshore Fisheries Resources Exploration in Southeast Asia	TD	JTF
10. Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region	TD	JTF
11. Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region	MFRDMD	JTF
12. Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region	MFRDMD	JTF
13. Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia	SEC	JAIF
14. SEAFDEC-EU/CITES Sharks Project Phase II	SEC	EU-CITES
Strategy II: Supporting the sustainable growth of aquaculture to complement fisheries and contribute to food security, poverty alleviation and livelihood of people in the region		
15. Environment-friendly, Sustainable Utilization and Management of Fisheries and Aquaculture Resources	AQD	JTF
16. Reinforcement and Optimization of Fish Health Management and the Effective Dissemination in the Southeast Asian Region	AQD	JTF

Strategy/Project Title	Lead Department	Funding Source
Strategy III: Ensuring the food safety and quality of fish and fishery products for the Southeast Asian region		
17. Chemicals and Drug Residues in Fish and Fish Products in Southeast Asia – Biotoxins (ASP, AZA and BTX) and Harmful Algal Bloom (HABs) in the ASEAN region	MFRD	JTF
Strategy IV: Enhancing trade and compliance of the region's fish and fishery products with market requirements		
18. Cold Chain Management for Seafood	MFRD	Singapore
19. Combating IUU Fishing in the Southeast Asian Region through Application of Catch Certification for Trading of Fish and Fishery Products	MFRDMD	JTF
Strategy V: Addressing cross-cutting issues, such as labor, gender and climate change, where related to international fisheries		
20. Assistance for Capacity Building in the Region to Address International Fisheries-related Issues	SEC	JTF
Strategy VI: Empowering SEAFDEC to strengthen its roles in the region and to improve its services to Member Countries		
21. Fisheries Resource Survey & Operational Plan for M.V. SEAFDEC 2	TD	JTF
22. Strengthening SEAFDEC Network for Sustainable Fisheries	SEC	JTF
Special Projects		
23. Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia	SEC	Sweden
24. The Oceans and Fisheries Partnership	TD	USAID

2) Departmental Programs

Program Title	Department	Funding Source
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. Priority and Special Projects	AQD	AQD*

Program Title	Department	Funding Source
7. Promotion on Strengthening of SEAFDEC Visibility and Image	TD	TD*
8. Tailor-made Training Programs	TD	TD*
9. Stock Assessment and Fish Production Potential of Inland Fisheries	IFRDMD	Indonesia
10. Center of Excellence for Fisheries Management on Inland Waters	IFRDMD	Indonesia

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

3) Other Programs

Program Title	Department	Funding Source
1. Implementing the Lower Mekong Fish Passage Initiative in Cambodia, Thailand, and Viet Nam	TD	US-DOI

SEAFDEC PROGRAMS OF ACTIVITIES IN 2018

The programs of activities of SEAFDEC in 2018 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 works of SEAFDEC was also guided by the “*Resolution on the Future of SEAFDEC: Vision, Mission, and Strategies Towards 2030*” adopted by the SEAFDEC Council during its special meeting on 15 November 2017. The results and progress of the implementation of programs and activities carried out in 2018 are structured based on the “*SEAFDEC Strategies Towards 2030*,” comprising: 1) Securing the sustainability of fisheries to contribute to food security, poverty alleviation and livelihood of people in the region; 2) Supporting the sustainable growth of aquaculture to complement fisheries and contribute to food security, poverty alleviation and livelihood of people in the region; 3) Ensuring the food safety and quality of fish and fishery products for the Southeast Asian region; 4) Enhancing trade and compliance of the region’s fish and fishery products with market requirements; 5) Addressing cross-cutting issues, such as labor, gender and climate change, where related to international fisheries; and 6) Empowering SEAFDEC to strengthen its roles in the region and to improve its services to Member Countries. In addition, SEAFDEC also implemented Special Projects which addressed cross-cutting issues that could not be categorized under particular Strategy. The programs of activities in 2018, including the Projects under the ASEAN-SEAFDEC FCG/ASSP Mechanism, Departmental Programs and Other Programs, could be summarized as follows:

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

1.1 **Assessment and management of marine fish stock**

Over the past decade, a number of Southeast Asian countries have expanded their interest in exploring the offshore fishery resources with a view to reducing the fishing pressure of near shore resources within their respective Exclusive Economic Zones (EEZs) that have already been overexploited, and at the same time finding alternative fishery resources that could be utilized in the future. Towards this end and through the project “**Offshore Fisheries Resources Exploration in Southeast Asia**,” SEAFDEC/TD has been providing technical support to the Member Countries in their efforts to explore the under-utilized fishery resources beyond their countries’ coastal areas including offshore areas within their respective EEZs. This has been done through the conduct of marine fishery resources and environment research surveys using the M.V. SEAFDEC 2, as well as human capacity building activities on subjects related to fishery resources survey and stock assessment.

As tunas are among the species being targeted under this project, TD continued to undertake studies on the stock structure of tunas in Southeast Asia with particular focus on skipjack tuna stocks using otoliths. Specifically in 2017, TD organized the “*Training Workshop on the Standard Methodology for Skipjack Otolith Collection*” to support the skipjack growth analysis. Subsequently in 2018, the “*Consultation and Site Visit for the Study on Skipjack Growth Analysis based on the Examination of Intervals between the Daily Rings in the Otolith Samples Collected from Sulu and Sulawesi Seas (SSSs) in Indonesia*”

was organized on 16-17 January 2018 where the activity plan for this study during 2018-2019 was thoroughly discussed. Moreover, TD also conducted the “Practical Workshop on Tuna Stock Assessment for Yellowfin Tuna, Bigeye Tuna and Skipjack Tuna Resources in Sulu and Sulawesi Seas (SSSs) by CPUE Standardization, Stock Assessments (ASPIC), and Kobe Plot (Stock Status Trajectory Plot)” on 21-24 February 2018 in Malaysia. Attended by eight (8) participants from Indonesia, Malaysia, and SEAFDEC/MFRDMD, the Workshop served as a catalyst in developing the human resources on stock assessment. By making use of the relevant information of yellowfin, bigeye and skipjack tunas from the SSSs, the participants enhanced their understanding of the procedures for tuna stock assessment based on CPUE Standardization, ASPIC, and Kobe Plot.



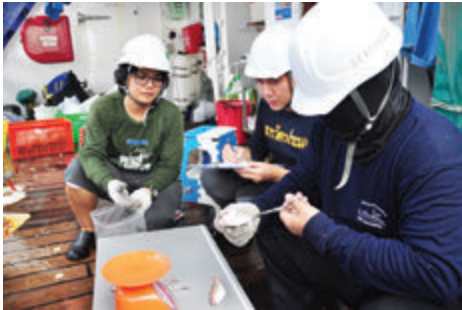
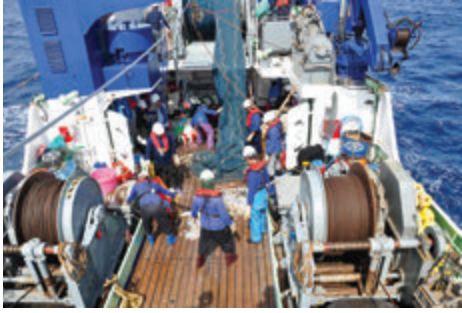
Consultation and Site Visit for the Study on Skipjack Growth Analysis based on the Examination of Intervals between the Daily Rings in the Otolith Samples Collected at Sulu-Sulawesi Seas (SSSs) in Indonesia (16-17 January 2018, Indonesia)



Practical Workshop on Tuna Stock Assessment for Yellowfin Tuna, Bigeye Tuna and Skipjack Tuna Resources in SSSs by CPUE Standardization, Stock Assessments (ASPIC), and Kobe Plot (Stock Status Trajectory Plot) (21-24 February 2018, Malaysia)

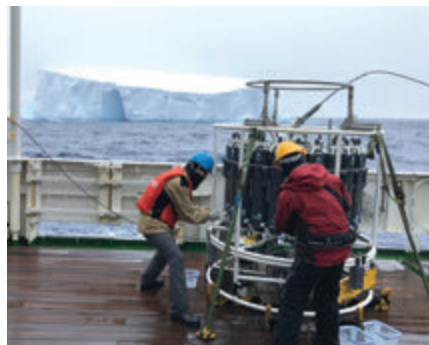
TD through the project “**Fisheries Resource Survey and Operational Plan for M.V. SEAFDEC 2**” also collaborated with the Fisheries Administration of Cambodia, the Department of Fisheries of Thailand, the Directorate of Fisheries of Viet Nam, as well as relevant agencies and academic institutions in Thailand to carry out the “Collaborative Research Survey on Marine Fisheries Resources and Marine Environment in the Gulf of Thailand” using the M.V. SEAFDEC 2. Conducted from 17 August to 18 October 2018, the 2018 Collaborative Research Survey led to: 1) Compilation of baseline data on marine fishery resources and marine environmental situation for scientific reference as well as the status of the marine fishery resources in the Gulf of Thailand; 2) Increased number of experienced researchers on marine fishery resources and marine environment in the SEAFDEC Member Countries; 3) Strengthened network of fisheries and oceanography scientists and researchers in Southeast Asia; and 4) Maximized efficiencies and benefits from the SEAFDEC research vessel and equipment to support the marine fishery resources and marine environment surveys in the SEAFDEC Member Countries.

Although TD had undertaken a number of fishery resources and environmental surveys in the Gulf of Thailand during the past years, such surveys focused mostly in the Thai waters. Thus, the 2018 survey which also involved Cambodia and Viet Nam had provided clearer and broader picture of the resources and environmental conditions of the entire Gulf of Thailand.



Researchers onboard the M.V. SEAFDEC 2 for the Collaborative Research Survey on Marine Fisheries Resources and Marine Environment in the Gulf of Thailand

Moreover, in supporting human resource development for the Member Countries, TD also extended its services through staff deployment to assist in the conduct of training courses in the Member Countries. During 27-31 August 2018, one staff from TD served as assistant resource person for the stock assessment training course in Thailand on “The Use of ASPIC Software and Kobe Plot for Assessing Status of Fisheries Resources”; during 24-27 September 2018, three staff from TD also supported the conduct of advance fishing gear specialists training in Malaysia. In addition, a fishery oceanographer from TD participated in the cruise survey onboard the T/V Umitaka-Maru from 31 December 2017 to 23 January 2018. Designed by Tokyo University of Marine Science and Technology (TUMSAT) under the project “Integrating Study Programme of the Marine Ecosystem of the Indian Ocean Sector of the Southern Ocean,” the cruise survey gave the opportunity for TD to enhance the capacity of its researcher in terms of acquiring additional knowledge and skills to support the Member Countries in the conduct of marine fishery resources surveys in the future.



The cruise survey on board the T/V Umitaka-Maru from 31 December 2017 to 23 January 2018



The biological group preparing the vertical multilayer plankton sampler for collecting plankton from depth 400 m to surface

In parallel with the exploration and assessment of marine resources, TD also continued to promote the full utilization of harvested resources for countries in Southeast Asia. At the national level, an “On-site Training Course on Proper Fish Handling Techniques Applicable to Local Fishing Vessels” was organized during 11-12 October 2018 in Yangon, Myanmar. Simple fish handling techniques such as icing technique, ice sweater chilling system and so on were introduced to the participants. As a result, the participants had enhanced their knowledge and practical skills in reducing post-harvest losses which include: 1) techniques on appropriate fish handling, including good fish handling practices and hygiene on-board; 2) technical information and knowledge related to preservation of fish for direct human consumption and maintain the fish’ premium quality level; and 3) techniques for reducing post-harvest losses and trash fish accumulation from unloading, storage, and transportation on-board until the unloading at landing sites.



The On-site Training Course on Proper Fish Handling Techniques Applicable to Local Fishing Vessels (11-12 October 2018, Yangon, Myanmar)



At the regional level, the “Regional Training Course on Fish Handling Techniques Applicable to Various Fishing Operations in Southeast Asia” was organized during 19-23 November at the TD premises in Samut Prakan, Thailand. The subjects imparted to the participants include: appropriate hygienic environmental and user friendly fish handling tools and simple techniques applied to maintain the quality of catch, fish handling techniques, ice storage, preservation techniques, transportation of fishery products, and promotion of food safety and minimizing post-harvest losses in catching, storing and transportation processes of fish. Awareness building on the reduction of post-harvest losses and promotion of food safety throughout the catching, storing and transportation processes was also embedded as an integral part of the regional training course.



The Regional Training Course on Fish Handling Techniques Applicable to Various Fishing Operations in Southeast Asia (19-23 November, Samut Prakan, Thailand)

On the sustainable management of marine fishery resources, SEAFDEC/MFRDMD implemented the project **“Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region”** that involved compilation and comparison of annual and/or monthly Catch Per Unit Effort (CPUE) data from purse seine fisheries during the past two decades in order to examine the status and trends of small pelagic resources that are targeted by purse seine fisheries in the region. Different fisheries management systems including Total Allowable Catch (TAC) system and other available management systems would be compared, while genetic study of a selected commercially important pelagic species would also be undertaken. At the end of this project, MFRDMD will review the available information including the stock levels, and examine the applicable management strategies for sustainable purse seine fisheries in the Southeast Asian region.

In 2018, MFRDMD conducted an “Internal Workshop on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region” on 12-14 February 2018 in Terengganu, Malaysia, where the most appropriate analysis for purse seine catch and effort data, *e.g.* Production Models and Allowable Biological Catch (ABC) Rules, was identified taking into consideration the limitations of the necessary data (availability and reliability) of the region. The issue on catch and effort data which could not be synchronized among countries was also considered. In order to augment the data provided by the respective countries, MFRDMD collaborated with Hokkaido University of Japan to conduct two surveys to collect additional data on species composition of the catch from purse seine fisheries at five major landing centers along the east coast of Peninsular Malaysia, on 1-10 July 2018 and during 24 September - 3 October 2018. Furthermore, study on genetic population of selected pelagic species was undertaken, after which the “Genetic Analysis Workshop for *Amblygaster sirm* and *Thunnus tonggol* in Southeast Asia” was conducted on 6-9 August 2018 in Langkawi, Malaysia.



An Internal Workshop on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region (12-14 February 2018, Terengganu, Malaysia)

To conclude the findings of this project, MFRDMD organized the “Fourth Core Experts Meeting on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region” on 18-19 September 2018 in Kuala Lumpur, Malaysia. With the final goal of formulating management measures for small pelagic fisheries in the Southeast Asian region, the Meeting shared and discussed the latest information on landings and CPUE data of purse seine fisheries in the region. The latest outputs of the regional synthesis of purse seine fisheries in the region and the findings on genetic population study on the pelagic species were also presented and discussed during this Meeting.



Participants of the Fourth Core Expert Meeting on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region (18-19 September 2018, Kuala Lumpur, Malaysia)

1.2 Assessment and management of inland fisheries

In Southeast Asia, inland aquatic resources are very rich in biodiversity making inland fisheries a very important sub-sector that contributes to food security, poverty alleviation as well as well-being of people particularly in the communities that are dependent on these resources. More attention should therefore be paid to securing the sustainability of inland fisheries sub-sector, as it is very much dependent on the quality of the aquatic habitats and ecosystems health, which are also shared by the other non-fisheries sector. This makes the initiative to ensure the sustainability of inland capture fisheries becoming very complicated.

To support the sustainable development of inland capture fisheries, SEAFDEC/IFRDMD implemented the project “**Promotion of Responsible Utilization of Inland Fisheries in Southeast Asia.**” The project is aimed at: 1) Reviewing the activities and the methodologies for promoting inland fisheries in the AMSs and finding a way forward for sustainable development of inland fisheries; 2) Seeking and promoting the effective management measures for the sustainability of inland fisheries in the AMSs; and 3) Studying and developing habitat conservation and resource enhancement measures suitable for the region. To achieve the first objective, IFRDMD picked up some major components and features of inland capture fisheries in the AMSs from the results of past surveys; and reviewed the available literatures, country reports, reports of relevant workshops, and websites. From such information, the draft document describing the present status, features, and issues faced by inland capture fisheries in the AMSs is being prepared by IFRDMD. As for the second objective, IFRDMD conducted field surveys in Viet Nam, Lao PDR, Myanmar, Cambodia, and Indonesia in 2018 to gather the relevant supporting information. Specifically, data on fish biodiversity and fisheries activities were collected from Tonle Sap Great Lake in Cambodia; Koto Panjang Reservoir and Barito River in Indonesia; and Nam Xouang Reservoir in Lao PDR using the data collection form and questionnaire survey developed by IFRDMD. Such data collection activities were supported by the selected enumerators in each area.



A



B



C



D



E

*Pictures during the field survey in
A: Viet Nam; B: Lao PDR;
C: Myanmar; D: Cambodia; and
E: Indonesia*

For Cambodia, the data were recorded on a daily basis starting from May until the end of 2018, and compiled to provide a basis for describing the location of fishing activities, operational time, types of fishing gear used, fish species caught, as well as the length and weight of selected species. For Indonesia, IFRDMD and the MMAF of Indonesia also collected data on bio-ecological parameters of aquatic organisms, such as fish biology, dynamic of fishery activities and socio-economic profiling of several locations in Barito River and Koto Panjang Reservoir. For Koto Panjang Reservoir (Sumatra Island), the data which were recorded on a daily basis from February to December 2018 described the fishing locations, fishing operations (such as fishing period and type of active fishing gears), and species and size composition of the catch. For Barito River (in Kalimantan Island), the data were recorded from March to December 2018.

Meanwhile, for the third project objective, IFRDMD supported the activity undertaken by SEAFDEC/TD in conducting surveys in Nam Xouang Reservoir in Lao PDR, and the installation of signboards to inform fishers on the regulations applied in the fish conservation zone established in the area (*See 1.4 on Promotion of innovative management tools and concepts applicable for the region*). In addition, IFRDMD also supported the setting up of fishing regulation signboard in Musi Banyuasin Regency, Indonesia.



The signboards installed in 2018: near Nam Xouang Reservoir of Lao PDR (left); and in Musi Banyuasin Regency in Indonesia (right)

IFRDMD conducted the “Regional Workshop on the Quantitative Study to Estimate Freshwater Fish Stock” on 21-22 November 2018 in Palembang, Indonesia to provide better understanding of the methods or approaches for conducting quantitative studies on freshwater fish stocks; explore and identify appropriate methods for freshwater fish stock assessment; discuss the strategic framework for implementing the appropriate methods simultaneously in the AMSs. Attended by officers and experts from agencies responsible for fisheries of the AMSs, namely: Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, and Thailand; as well as regional and international experts from universities and research institutes, and relevant government agencies in Indonesia, the Workshop recognized the need to improve the assessment of the fish stock status by developing and improving standard data collection system; exploring the use of novel fisheries assessment methods, such as mobile technology, GIS tools, remote sensing, e-DNA; and establishing partnership with various organizations to store and jointly analyze information that could be used for inland fisheries assessment and management. The need for stock assessment of endangered and threatened freshwater species under international concern, and appropriate habitat improvement including fish passage and restocking strategies were also discussed.

To support better understanding of the various aspects of fisheries management and conservation by its researchers, and to generate baseline data and information on inland capture fisheries, IFRDMD participated in various training opportunities, in-house or foreign training. In so doing, IFRDMD is able to learn from the experiences of the Mekong River Commission (MRC) on the management of inland capture fisheries. IFRDMD also enhances the capacity of its human resources through the “Training Course on Introduction of Simple Stock Assessment Methods in Inland Fisheries” on 19-20 September 2018 at the TD premises in Samut Prakan with invited lecturer from Tokyo University of Marine Science and Technology (TUMSAT) Japan.

1.3 Development and promotion of regional measures and tools for combating IUU fishing

During the past decade, countries in the Southeast Asian region have placed enormous efforts on the promotion of sustainable fisheries through appropriate development and implementation of measures to combat Illegal, Unreported and Unregulated (IUU) fishing with greater recognition on the importance of fishery management schemes, such as

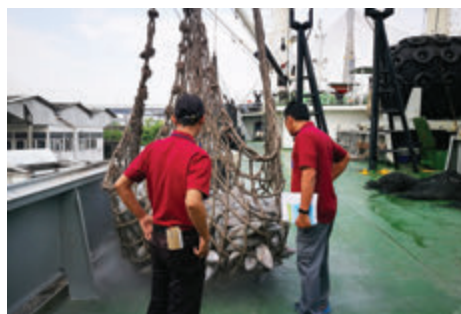
fishing gear licensing, fishing vessels registration, and so on, as effective measures to promote sustainable utilization and the long-term conservation of marine living resources. At the regional level, SEAFDEC was requested to take the leading role in the development and promotion of regional measures and tools for combating IUU fishing. Toward this, SEAFDEC/TD has continued to implement the project **“Promotion of Countermeasures to Reduce IUU Fishing”** since 2013, and in 2018, focus was placed on three approaches, namely: 1) development of the Regional Fishing Vessels Records (RFVR); 2) supporting regional cooperation for the implementation of Port State Measures (PSM); and 3) promotion of the ASEAN Catch Documentation Scheme (ACDS).

The “Regional Meeting on the Regional Fishing Vessel Record (RFVR) for Vessels 24 Meters in Length and Over as a Management Tool Toward Combating IUU Fishing in ASEAN Region” organized during 12-13 December 2018 at the TD premises in Samut Prakan, Thailand, provided the means of updating the information on the number of fishing vessels by size (category) and by type of fishing, while the mechanism and timeline for sharing of information on fishing vessels from the AMSs for the RFVR database were agreed upon. Furthermore, the way forward for the AMSs and SEAFDEC to support the activities that aim to prevent, deter and eliminate IUU fishing through the use of RFVR was discussed, together with the possible expansion of the RFVR database to include vessels of less than 24 meters in length, considering the large number of these type of small fishing vessels in the region.

In another scope of work on the regional cooperation for PSM implementation, SEAFDEC with the cooperation of the Food and Agriculture Organization of the United Nations (FAO) and the U.S. National Oceanic and Atmospheric Administration (NOAA), organized the “Regional Training on Port State Measures Implementation in Southeast Asia” on 20-23 February 2018 in Bangkok, Thailand. Participated by 46 fisheries managers from the SEAFDEC Member Countries (except Lao PDR), the Training was able to establish the national legal aspects, policies, and institutions for the PSM implementation and PSM inspection of vessels; and learned the experience of Thailand on the implementation of PSM.



The Regional Meeting on the Regional Fishing Vessel Record (RFVR) for Vessels 24 Meters in Length and Over as a Management Tool Toward Combating IUU Fishing in ASEAN Region (12-13 December 2018, Samut Prakan, Thailand)



The Regional Training on Port State Measures Implementation in Southeast Asia (20-23 February 2018 in Bangkok, Thailand)

On the ASEAN Catch Documentation Scheme (ACDS), the possibility of introducing the ACDS in Myanmar was explored while the promotion of the ACDS in Brunei Darussalam was still on-going. In this connection, TD in collaboration with the Department of Fisheries, Myanmar organized the “Consultation Meeting on Introduction of the Electronic ASEAN Catch

Documentation Scheme (eACDS)” from 12-13 June 2018 in Yangon, Myanmar. The electronic ACDS system including the process of issuing catch declaration, movement documentation, catch certification, processing statement, and re-export certification were introduced and demonstrated to stakeholders that include fishers, fish buyers, fish processors, importers, exporters, and relevant government officials. The “Consultation Visit on Port State Measures (PSM)” was also made in conjunction with the Consultation Meeting to obtain updates on and observe the situation of PSM implementation in Myanmar by visiting the fishing port in Yangon.



Stakeholders Meeting on Electronic System of ASEAN Catch Documentation Scheme in Myanmar

1.4 Promotion of innovative management tools and concepts applicable for the region

In the Southeast Asian region, the availability of fishery statistics is recognized as under-reported in coastal and inland fisheries due to the nature of these fisheries, being multi-species and involving large number of small-scale fishers. This situation made it necessary to improve the methodology for the collection of data and information, by acknowledging the concept and theoretical framework of fisheries management, *e.g.* by involving the local communities and local officers among others, in data collection to ensure that the collected data clearly reflect the importance of coastal and inland fisheries and could be used as basis for planning and management of these fisheries. In this regard, SEAFDEC/TD implemented the sub-project “**Facilitating fisheries activity information gathering through introduction of Community-based Resources Management/Co-management**” under the regional project “**Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region**” starting 2013. This sub-project is aimed at: 1) Improving the compilation of fisheries and socio-economic information on coastal small-scale and inland fisheries in Southeast Asia; 2) Supporting the SEAFDEC Member Countries in the adoption of applicable practice of CBRM/Co-management; and 3) Facilitating better understanding of and enhancing knowledge on the status and condition of coastal small-scale and inland fisheries at national and local levels, with pilot sites in Cambodia, Lao PDR and Thailand.

For Cambodia, TD completed the planned activities in the project site in Chong Khneas Commune in Siem Reap in 2018, where technical support was provided on conservation zone management and for the other activities under the Community Fisheries Management Plan using CBRM/Co-management approach during 25-27 June 2018. Through the technical advice provided by TD, the 12 members of the Community Fisheries enhanced their knowledge on the management plan, especially on conservation zone management and eco-tourism activities.

For Lao PDR, the activities focused on the promotion of CBRM and Co-management in fishing communities in Nam Xouang Reservoir, Vientiane Province, where TD provided technical assistance to the concerned fisheries officers for them to gain better understanding of the CBRM and Co-management concepts, as well as to design fishery management plans based on participatory mechanism using the co-management approach. Activities were also conducted in Nam Xouang Reservoir, Lao PDR during 30 January - 3 February 2018 to strengthen and unify the rules and regulations of Phone Hong and Naxaythong Districts that are located in the reservoir area. On 11-16 June 2018, buoys for demarcation of conservation zone as well as the sign boards to inform the rules and regulations to the local fishers were installed. Mobile hatchery system was introduced to the communities through the training course conducted on 25-29 June 2018 to provide adequate quantities of fish fingerlings to be released to the reservoir as part of the management plan. In addition, collection of data on fishery activities, fish species, stock assessment, as well as socio-economic status of fishers was also undertaken in collaboration with SEAFDEC/IFRDMD (*see 1.2 on Assessment and management of inland fisheries*). Through the involvement of local fisheries officers in the implementation of these activities, their capacity had been strengthened and they are expected to be able to apply the CBRM and Co-management concept in their localities in the future, to support fisheries information gathering and management towards the sustainable utilization of the resources.



Discussion and sharing of experiences on CBRM/co-management project with researchers



Preparation and installation of buoys for demarcating the conservation zone and sign board

Banmai Namprakan Village in Khammouane Province is another project site in Lao PDR, where the Fisheries Management Committee (FMC) and conservation zone were established. Since March 2018, surveillance activity was conducted by the Patrolling Unit to monitor illegal fishing activities in the conservation zone. Fish releasing activity was also conducted during the National Fish Releasing Day of Lao PDR on 13 July 2018 to enhance the awareness of community members on the need to preserve the fisheries resources.

Subsequently on 5-8 September 2018, a training course on fish processing techniques was conducted to promote alternative livelihood to the women's group. Catch statistics and data were collected through fish market survey to provide supportive information for the development of project activities and monitoring of the status of fishery resources in the area.



*National Fish Releasing Day of Lao PDR
on 13 July 2018*



*Training course on fish processing techniques to
promote alternative livelihood
to the women's group*

Meanwhile, at the project site in Nam Oon Dam, Sakhon Nakhon Province, Thailand, stock assessment research was conducted that involved the assignment of a local enumerator for the collection of monthly catch landing data and dispatch of the landing data to the project staff of TD for analysis. In addition to the local enumerator, 32 volunteer fishers also participated in data collection by recording their catch data into the logbook, where such data would serve as one of the key references to support the stock assessment research.



*Data collection for stock assessment
at Nam Oon Dam
in Sakhon Nakhon Province*

1.5 Development and promotion of responsible fishing technologies

In 2018, SEAFDEC/TD continued to undertake projects and activities that aim to develop and promote responsible fishing gears with a view to improving the practice of optimizing energy use in fishing operations, improving safety at sea, reducing the use of labor in fishing operations through improved vessel and fishing gear design, as well as improving the working conditions of fishers onboard fishing vessels to comply with international requirements.

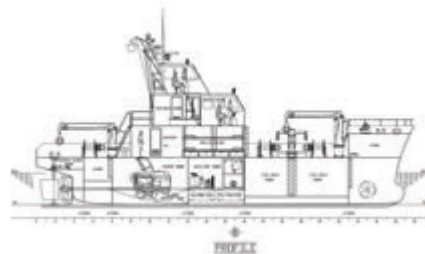
The regional project **“Optimizing Energy Use/Improving Safety in Fishing Activities”** has been implemented by TD since 2013 with the objectives of transferring appropriate knowledge and enhancing awareness on optimizing energy use in fishing activities, and

promoting safety at sea for small fishing vessels in the SEAFDEC Member Countries. On 8-10 October 2018, the “On-site Training on Optimizing Energy and Safety at Sea for Small Fishing Vessels” was organized in Myanmar with the aim of gaining better understanding among the fishers and stakeholders of energy saving and safety at sea, and establishing stakeholders network for safety at sea of small fishing vessels. For such purpose, the technical handbook “Energy Saving Measures and Safety Recommendation for Fishing Vessels” was translated into the Myanmar language, and printed for distribution during the training.



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

TD also collaborated with the Department of Fisheries (DOF) of Thailand and relevant national agencies to explore the new design of fishing vessels appropriate and practical for the Southeast Asian region taking into consideration the national and relevant international standards and requirements including those of the International Labor Organization (ILO) Convention 188: Work in Fishing (C188). On 5 March 2018, the “Workshop on Appropriate New Purse Seine Fishing Vessel Design” was organized at the TD premises in Samut Prakan, Thailand with participants from the DOF and relevant agencies. While also promoting and improving awareness on energy efficiency and reduction of the impact of greenhouse gas from fishing vessels in Southeast Asia, the Workshop facilitated the exchange of views on the concept of appropriate fishing vessels’ design to support fuel efficiency, safety at sea, good working and living conditions as well as reduction of manpower onboard fishing vessels.



Workshop on Appropriate New Purse Seine Fishing Vessel Design (left), and the initial drawing of new design for seine vessel appropriate for Thailand (right)

TD has been collaborating with the Department of Fisheries and the private sector in Thailand since 2017 to implement the “Demonstration Boat Project.” Aimed at raising awareness on the need to improve safety, health, work and living conditions of onboard fishing crew in line with international standards and requirements, the renovation plan of the SEAFDEC vessel, the “M.V. PLALUNG 1,” a trawler type vessel with the length overall (LOA) of 17.5 meters and capacity of 35 GT, was agreed upon by DOF Thailand and SEAFDEC. The renovation was meant to equip the vessel with navigation equipment and necessary

components for the comfort of the fishing crew, *e.g.* proper kitchen area, mess room, enclosed rooms for toilets and shower along with a decent sleeping area. The project which also aimed to improve the working condition onboard fishing vessels, installed a net drum to the rear of the vessel to reduce the amount of labor, operating cost and the speed in casting and retrieving the net. The inauguration of the demonstration boat, the M.V. PLALUNG 1 was held on 28 February 2018 at TD in Samut Prakan, Thailand.



The renovated M.V. PLALUNG 1 serving as demonstration boat



Inauguration of the Demonstration Boat

In 2018, TD also started another activity in collaboration with the Department of Fisheries of Thailand and the Thai Fisheries Association as well as with a local purse seine owner in Pattani Province for the “Purse Seine Net Modification Using Net Hauler and Deck Machinery.” This project was aimed at addressing one of the biggest challenges faced by the Thai fisheries sector on shortage of fishing crew onboard purse seiners by installing net power block and deck machinery that would reduce the crew requirement for fishing operations. In addition, on-board cold storage system was improved with a view to elevating the quality and freshness of the catch as well as its safety for human consumption. It is expected that such modification would also reduce relevant operation cost and administrative preparation for the fishing cruise in the long run. For the first quarter of 2019, the actual operation of the modified purse seiner would be started and TD will continue to collaborate with the DOF and relevant national agencies in Thailand to undertake the socio-economic analysis of such modification, *e.g.* on investment and maintenance cost, gear efficiency, costs and returns from fishing operations, and so on.



Commercial purse seiner used for the modification project



Crane and power block installed on the purse seiner

1.6 Integration of habitat and fisheries management and provision of support for the conservation of important fishery resources

Integration of habitat and fisheries management

Under the integration of habitat and fisheries management towards conservation of important marine fishery resources, SEAFDEC/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: 1) obtaining the information on fishery resources enhancement and habitat conservation measures in Southeast Asia; 2) supporting the human resource development for implementing fishery resources enhancement and habitat conservation measures; and 3) promoting good practices on fishery resources enhancement and habitat conservation measures suitable for Southeast Asia.

In 2017, TD has completed the survey on the design and construction of Fish Enhancing Devices (FEDs) by small-scale fishers in the eastern and western parts of the Gulf of Thailand, which would be continued in 2018 along the coast of the Andaman Sea to identify the different designs and construction factors of FEDs suitable for different localities and fishing grounds. Specifically, the survey was conducted from 19 to 31 January 2018 in five provinces, namely; Ranong, Phung-Nga, Krabi, Trang, and Satun Provinces, and came up with: 1) a Guide to introduce different designs and factors for FEDs construction and installation, as well as the appropriate management for enhancing their effectiveness (types, factors, designs, construction, and management); 2) a Mapping of FEDs installation in important fishing grounds and habitats in the Andaman Sea; 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 the design and construction of Fish Enhancing Devices (FEDs) by small-scale fishers along the coast of Andaman Sea

Also within the framework of this project, TD collaborated with the Faculty of Marine Technology, Burapha University, Chanthaburi Campus to undertake the study on “Environmental and Socio-economic Impact of the FEDs in Coastal Area of Trat Province Thailand,” with the main objective of obtaining understanding on the impact of rope FADs on the ecosystem and the fishing community. This study would be completed in 2019.

At the regional level, the “Regional Technical Meeting on the Fisheries Resources Enhancement in Southeast Asia” was organized during 24 to 26 April 2018 in Bangkok, Thailand. The participants from the Member Countries (except Philippines), were updated

on the plan and implementation of national and regional activities on the enhancement of fishery resources. As a result, the Meeting came up with: 1) national and regional information on fishery resources enhancement programs and activities carried out in Southeast Asia; 2) information on management measures for fishery resources enhancement at national level; 3) network of scientists working on fishery resources enhancement in SEAFDEC Member Countries; and 4) recommendations from SEAFDEC Member Countries on the implementation of fishery resources enhancement programs that would guide SEAFDEC in gathering more information and providing the direction to develop short-term and long-term activities to support the Member Countries in 2020-2025.



*The Regional Technical Meeting
on the Fisheries Resources
Enhancement in Southeast Asia
(24-26 April 2018,
Bangkok, Thailand)*

Moreover, TD also continued to implement the project **“Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand”** supported by the Global Environment Facility (GEF) to integrate habitat and biodiversity conservation considerations into fishery management and practices. Implemented by the United Nations Environment Programme (UNEP) and executed regionally by TD in partnership with the government agencies responsible for fisheries of six participating countries, namely Cambodia, Indonesia, Malaysia, Philippines, Thailand and Vietnam, the Project promotes the fisheries *refugia* approach with the objective of safeguarding the habitats critical to the life cycles of important fisheries resources as this would not only improve and secure biodiversity but also build resiliency for those relying on the oceans for food and livelihoods. By improving the way that the ministries responsible for fisheries and environment, work together with all stakeholders concerned, and linking fishing efforts with coastal management practices, this initiative would provide multiple benefits to the marine ecosystem and the people.

Under the “Letters of Agreement” signed in 2017 by four participating countries, namely: Cambodia, Malaysia, Philippines, and Thailand, a governance review, stakeholder analysis, socio-economic information and data compilation, and review of existing management arrangements, have been carried out in the participating countries. The working document on key threats from fishing and the environment to fish stocks and critical habitat linkages at the priority sites in the participating countries was also prepared for review at the regional level. Nevertheless, for Indonesia and Viet Nam, obtaining of the countries’ endorsement of the “Letter of Agreement” was still under negotiation process.

To ensure the effective implementation of activities during the project execution and to provide sound scientific and technical advice for consideration by the Project Steering Committee, the “Regional Scientific and Technical Committee Meeting” (RSTC Meeting)

was organized on 11-13 September 2018 in Trat Province, Thailand. The specific objectives of the RSTC Meeting were to create regional cooperation in the integration of scientific knowledge and research outputs with management, and update on the progress of work implemented by participating countries and the PCU. As of 2018, the 10 priority fisheries *refugia* sites and the activities for implementation in four countries, were identified as follows:

1) Cambodia:

- Kep Province - for blue swimming crab *refugia* in sea grass area;
- Kampot Province for juvenile grouper *refugia* in the coral reef area; 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 blue swimming crab *refugia*.

3) Malaysia:

- Tanjung Leman, Johor Bahru – for spiny lobster *refugia*; and
- Bintulu, Sarawak – for tiger prawn *refugia*

4) Philippines:

- Bolinao, Pangasinan - for rabbitfish (*Siganus* spp.) *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.

In addition, at the RSTC Meeting, the three (3) fisheries *refugia* sites and priority species proposed by Indonesia were noted, namely: in Bangka-Belitung and Tambelan-Bintan for *refugia* of small pelagic fishes; and Bengkayang for shrimps. Viet Nam did not identify the priority species as yet. The existing laws and regulations relevant to these identified fisheries *refugia* sites have been compiled and reviewed, and the feedbacks will be provided to national project team of the respective countries to facilitate the formulation of recommendations on policy and legal reforms to support the promotion of responsible fishing at times and locations that are critical to fish stocks and critical habitat linkages.

Subsequently, the “1st Project Steering Committee (PSC) Meeting” was organized on 4-5 December 2018 in Bangkok, Thailand to create the regional cooperation in the establishment and operation of a regional system of fisheries *refugia*. The PSC Meeting was able to: 1) adopt the terms of reference for all institutional frameworks for regional (PSC and RSTC) and national levels (National Lead Agency, National Fisheries *Refugia* Committee, National Scientific and Technical Committee, Site-based Management Boards as well as the TOR for the Project Coordinating Unit (PCU); 2) agree on the national results framework and proposed workplan adjustment for 2019 and onwards; 3) adopt the Report of the Chairperson of the 1st Meeting of the Regional Scientific and Technical Committee; 4) support the financial arrangements for national and regional programs; and 5) endorse the expenditures and co-financing for participating countries and the SEAFDEC/PCU from 2017 to 30 September 2018.



Fisheries refugia sites identified in the participating countries (except Viet Nam)

Conservation and management of sharks and rays

During the past decades, several commercially-exploited marine species including sharks and rays had been the focus of international concern that prompted the development of the International Plan of Action for the Conservation and Management of Sharks by FAO in 1998, and submission of subsequent proposals for listing of several sharks and rays in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Sharks were first included in Appendix II of CITES in 2003 during the 12th Meeting of the Conference of the Parties to CITES (CITES-CoP12). Up to the present, 12 species of sharks (*Cetorhinus maximus*, *Rhincodon typus*, *Carcharodon carcharias*, *Lamna nasus*, *Carcharinus longimanus*, *Sphyrna lewini*, *S. mokarran*, *S. zygaena*, *Carcharinus falciformis*, *Alopias pelagicus*, *A. vulpinus*, and *A. superciliosus*), and all species of manta rays (*Manta* spp.) and devil rays (*Mobula* spp.) have been listed in Appendix II of CITES. In addition, seven species of sawfishes (*Pristidae* spp.) have already been 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. Through MFRDMD, TD and the Secretariat, SEAFDEC has implemented several projects that complete the puzzle on addressing the various aspects of concerns on sharks and rays.

Under the auspices of MFRDMD, the project “**Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region**” was implemented since 2013 with the objectives of: 1) Training technical officers in the participating Member Countries on the collection of taxonomic and biological data on sharks and rays in their respective countries; 2) Obtaining genetic information on shark and ray species in the region by DNA barcoding; and 3) Collecting information on the usage of sharks and rays in the region for proper fishery management and sustainable utilization. The countries involved in this project include Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam.

The “Study on Taxonomy and Biology Using Morphometric and Meristic Data, and DNA Barcoding Methods” conducted from 2017 in Viet Nam (Vung Tau and Binh Dinh)

and Cambodia (Preah Sihanouk), was continued in 2018 considering that the necessary information from these two countries were still insufficient. Specifically, for Viet Nam, MFRDMD in collaboration with the Directorate of Fisheries under the Ministry of Agriculture and Rural Development, organized the “Advanced On-site Training on Chondrichthyans Taxonomy and Biology” on 25-26 September 2018 in Vung Tau. Through this training, the capacity of Vietnamese researchers in chondrichthyans taxonomy and biology had been strengthened, while they were also trained on laboratory methodologies which include identification of species of sharks, rays and skates, and measurement techniques for proper recording of these species. Two papers from the results of the studies undertaken in Viet Nam were presented during the Training, namely: 1) DNA Barcoding result of sharks, rays and skates collected in 2017 in Viet Nam, and 2) Review of biodiversity of sharks in Viet Nam. Furthermore, eleven (11) species, comprising 6 species of sharks and 5 of rays, were also collected during the Training as the new samples for DNA barcoding analysis in 2018. Meanwhile, a study on DNA Barcoding of angle sharks was also carried out in Phuket, Thailand in collaboration with local researchers.



Participants of the Advanced On-site Training on Chondrichthyans Taxonomy and Biology



Shark taxonomy and biology study conducted in Phuket, Thailand

MFRDMD had managed to obtain DNA sequences from 141 sharks, 251 ray and 18 skate until 2018, for DNA barcoding. The specimens were from 40 species of sharks, 36 species of rays and 2 species of skates, and 68% of the data has been uploaded to BOLD database system (<http://boldsystems.org>). These results were presented during “Core Expert Meeting on Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region” in October 2018, and would also be presented during the “National Research Symposium” to be organized in Penang, Malaysia in January 2019.

In 2018, MFRDMD also conducted the “Survey on Fishers Dependencies, Marketing and Trade of Sharks and Rays in Java and Sumatera, Indonesia.” The team from MFRDMD and Indonesian counterparts visited the sharks and rays landing sites at Pelabuhan Ratu, Cilacap, Surabaya and Semarang in Java; and at Lampulo in Sumatera. From the survey results, it was recommended that Indonesia needs to develop Non-Detriment Findings or NDFs for all CITES-listed species of sharks and Mobulas, particularly for the silky and thresher sharks. Moreover, SEAFDEC under the SEAFDEC-EU/CITES Sharks Project Phase II should work closely with the Ministry of Marine Affairs and Fisheries of Indonesia to organize a workshop in Indonesia on the development of NDFs, which should also include testing of the new NDFs modified from that of Germany’s that appears to be more user-friendly. Furthermore, data collection for CITES-listed species (up to the species level)

should be conducted at all major ports in Indonesia for several years in order to come up with reliable biomass estimation, with possible financial support from SEAFDEC. It was also noted that based on the survey conducted by MFRDMD, some shark and ray products found in Java could have originally come from other islands, such as Bali, Sulawesi and Kalimantan. A similar survey should therefore be conducted in these sites in 2019, to confirm such observation.

To conclude the Project activities in 2018, MFRDMD organized the “Core Experts Meeting on Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region” on 9-10 October 2018 in Kuala Lumpur, Malaysia, which was attended by the representatives from Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Viet Nam, SEAFDEC Secretariat, TD, and MFRDMD, as well as resource persons from Japan Fisheries Research and Education Agency; as well as from Kasetsart University and Ubon Ratchathani University of Thailand. The Meeting discussed the current landing data collection and trade of sharks and rays, and discussed the way forward to improve the data/information collection towards the sustainable utilization of sharks and rays in the Southeast Asian waters after the completion of this Project in 2019 (e.g. under the new phase of the Japanese Trust Fund project). Results of the DNA study of MFRDMD and the marketing study in Indonesia were presented during this Core Experts Meeting.



Survey on fishers' dependencies, marketing and trade of sharks and rays in Java and Sumatera, Indonesia



Participants of the Core Experts Meeting on Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region

Updated materials on sharks and rays are being produced, e.g. manuscript for Volume 2 of the “Identification Guide to Sharks, Rays and Skates of the Southeast Asian Region” with particular focus on deep water chondrichthyans found in the Southeast Asian region which is being finalized for publication in 2019, paper on “Biodiversity and Habitat Preferences of Living Sharks in the Southeast Asian Region” was prepared and presented during the “Second Indonesia Shark and Ray Symposium” on 28-29 March 2018 in Jakarta, Indonesia, which was subsequently published in the Indonesian Fisheries Research Journal (Volume 24, No 2, December 2018).

As a supplementary to the aforementioned project, TD also carried out the sub-project “**Data collection of the commercially-exploited aquatic and threaten species**” under the project “**Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region,**” aimed at: 1) Enhancing the capability of the Member Countries in compiling and utilizing

fishery statistics and information of sharks and rays at the species level; 2) Supporting the Member Countries in the development of their respective National Plans of Action for sharks and rays; and 3) Providing scientific evidence for sustainable management of sharks and rays fisheries in the region. In 2018, TD in close collaboration with MFRDMD conducted the “Technical Meeting on Sharks and Rays Data Collection Planning 2018-2019” on 10 April 2018 in Samut Prakan, Thailand with participants coming from the pilot countries, namely: Thailand, Malaysia, and Indonesia. The Meeting came up with the workplan for one-year data collection of sharks and rays to be undertaken in the pilot countries starting from July 2018 to June 2019. The landing sites selected were in Songkhla Province (Thailand) and Tawau (Sabah, Malaysia) for demersal sharks and rays; and in Cilacap (Indonesia) for pelagic sharks and rays.

In 2018, TD also continued its activities that aim to determine the appropriate model for converting sharks and rays data into scientific stock information that could be used to support the management of sharks and rays. Through the technical consultation in 2017, the “Yield Per Recruit” Model or YPR Model was identified as one of the most appropriate methods for examining the resource and fishery status of sharks and rays in the region considering that historical information on recruitment of the fish population being studied is limited. TD therefore conducted the “Training Workshop on Sharks and Rays Stock Assessment by YPR Model” on 4-9 June 2018 in Samut Prakan, Thailand. Attended by participants from Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam, the Workshop was aimed at: enhancing human resource development on stock assessment of sharks and rays for researchers of the Member Countries; increasing the number of stock assessment information on sharks and rays by species in the region; and establishing a network among stock assessment scientists in the Southeast Asian region.



*Training Workshop on Sharks and Rays Stock Assessment by YPR Model
(4-9 June 2018, Samut Prakan, Thailand)*

To ensure the sustainable utilization of shark and ray resources, another important scope of activity was undertaken starting in 2018 through the project “**SEAFDEC-EU/CITES Sharks Project Phase II**” by SEAFDEC Secretariat in collaboration with TD and MFRDMD to support the development of Non-Detriment Findings (NDFs) to fulfill the CITES provisions for trade in Appendix-II listed sharks and rays. The target countries for this project include those that have insufficient information such as Cambodia, Myanmar, Philippines, and Viet Nam, as well as those that have sufficient information for the development of NDFs, namely Indonesia, Malaysia, and Thailand. By assisting the Parties of CITES having more comprehensive data sets and information available for developing the NDFs, the Project would be able to facilitate the establishment of the best practice examples for the region. Simultaneously, for those Parties in the region that have no or limited information available,

because of insufficient data on catches of CITES-listed shark species, the Project would also be able to support the primary collection of data to make sure that all Parties in the region are able to have robust NDFs in the future.

The activities under this project in 2018 focused mainly on the conduct of capacity building for enumerators in countries with insufficient information to enable them to improve the collection of data on sharks and rays at landing sites. In this regard, series of “National Workshops and Training on Sharks Data Collection for Enumerators” were organized in Yangon, Myanmar on 22-24 July 2018; in Sihanoukville, Cambodia on 20-22 August 2018; and in Vung Tau, Viet Nam on 27-28 September 2018. To complete such series of national workshops and training, the training would be conducted in the Philippines in January 2019. The budget had also been allocated for the conduct of 1-year data collection by these countries that would enable them to come up with sets of data that could support development of NDFs in the future.



National Workshop and Training on Sharks Data Collection for Enumerators” held in Myanmar (top left), Cambodia (top right), and Viet Nam (left)

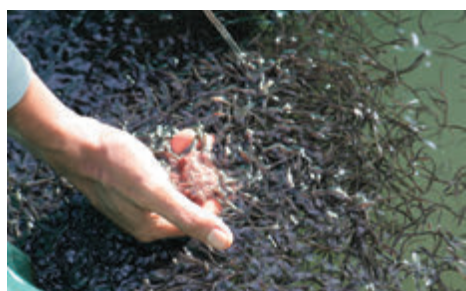


Conservation and management of catadromous eels

Catadromous eels (*Anguilla* spp.) have been considered as important commercial aquatic species because of their nutritional value and preference especially in the East Asian countries. With the rapid decline of temperate eels, and the listing of some Anguillid eel species, *i.e.* *Anguilla anguilla* 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 the tropical zone has also increased dramatically, posing risks for the possible 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 to avoid over-exploitation of the species.

In 2018, SEAFDEC continued to implement the two regional projects that aimed to address the emerging needs for ensuring the sustainable utilization of catadromous eel resources. The first project “**Enhancement of Sustainability of Catadromous Eel Resources**

in Southeast Asia” is aimed at obtaining clear understanding on the current situation of resources, fisheries, and utilization of catadromous eels in the region; improving data collection and statistics of catadromous eel catch in the AMSs; and enhancing knowledge and capacity in the AMSs for the conservation, management and sustainable utilization of catadromous eel resources. Implemented by IFRDMD since 2015 and scheduled to be completed in 2019, the first project started with a baseline study in the AMSs where anguillid eel fisheries are practiced, *i.e.* in Cambodia, Indonesia, Myanmar, Philippines, Thailand, and Viet Nam, by IFRDMD in collaboration with AQD to find out the current status of eel fisheries in Southeast Asia. The data and information compiled include those on eel fishery targeting different stages of eels, eel farming, existing regulation, utilization, catch assessment survey, and biological monitoring. The study came up with a matrix of Anguillid eel fisheries within the AMSs, which showed that the highest glass eel production was from the Philippines, followed by Indonesia and Viet Nam; while for yellow eels, the country with the highest production was Indonesia, followed by Myanmar and Philippines. Surveys on culture practices were undertaken in Indonesia, Philippines, Myanmar, Cambodia and Viet Nam; while catch assessment surveys and biological monitoring were conducted in countries with large quantities of catch, namely Indonesia and Philippines.



Glass eel feeding



*Power plant at Cilacap, Indonesia
(near river mouth)*

In an effort to improve the data collection and statistics of catadromous eel catch in the AMSs, IFRDMD established the data collection system for countries where eel statistics data collection system is not yet in place, *e.g.* in Myanmar and Viet Nam. The available metadata were grasped and shared as baseline information on the present status, features, and the issues on eel fisheries that should be monitored in the countries. Furthermore, for promotion of appropriate management of eel fisheries and for the sustainable use of tropical eel resources in the region, IFRDMD also compiled the information on possible environmental impacts on eel fisheries, which presumably include the existence of the dams and power plants at the river mouth, as well as habitat alterations that changes the migratory routes of the species. In 2019 as the final year of this project, IFRDMD will organize a workshop to review the project results throughout the previous years and develop guidelines on the conservation, management and sustainable utilization of catadromous eel resources in the region. The guidelines would be disseminated to enhance public awareness on the conservation and management of eels for sustainable utilization in the AMSs.

The second project **“Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia”** is being implemented by SEAFDEC Secretariat in collaboration with IFRDMD and AQD and aims to strengthen and consolidate eel resource management framework for sustainable provision of eel products and

eel capture fisheries/eel farming in the AMSs. At the outset, the first “Regional Experts Meeting” was convened by SEAFDEC on 25 January 2018 in Bangkok, Thailand to review the eel data collected through relevant projects on anguillid eels. Subsequently, on 7-8 June 2018, SEAFDEC organized the “International Technical Workshop on Tropical Anguillid Eels in Southeast Asia” also in Bangkok, Thailand. The recommendations from the Workshop and findings from the eel project undertaken by SEAFDEC were compiled into the “Information Document” for the 30th Animals Committee Meeting (AC30) of CITES held on 16-21 July 2018 in Geneva, Switzerland, where the issue on Tropical Anguillid Eels was raised. On 18-19 October 2018, SEAFDEC organized the “Second Regional Meeting on Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eels in Southeast Asia” with representatives from the AMSs, experts from Japan, members of the Assessment Committee and representatives from SEAFDEC/IFRDMD, AQD, and the Secretariat in attendance. Based on the progress and achievements from data collection during January to October 2018 presented at the Meeting, recommendations for improving future survey methods were made. Furthermore, the Meeting also discussed the resources management policy and the countries’ management schemes, which shall serve as basis for the development of guidelines for the countries in managing their respective eel fishery resources.



An International Technical Workshop on Tropical Anguillid Eels in Southeast Asia (7-8 June 2018, Bangkok, Thailand)



The CITES International Workshop on Conservation, Management, Fisheries and Trade in Eels (Anguilla spp.),” 18-20 April 2018 in London, UK where the progress of ongoing study on tropical Anguillid eels in Southeast Asia was presented



The 2nd Regional Meeting on Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia (18-19 October 2018, Bangkok, Thailand)

In addition to the aforementioned two projects on catadromous eels, SEAFDEC Secretariat was also in the process of securing funding from the Japan-ASEAN Integration Fund (JAIF) for another one-year project “**Development of Stock Assessment Method and Strengthening of Resources Management Measures on Tropical Anguillid Eels in ASEAN Region.**” When funding could already be secured, the project would be implemented starting in 2019.

Conservation and management of neritic tunas

After the endorsement of the “Regional Cooperation for Sustainable Utilization of Neritic Tunas in the Southeast Asia” and the Terms of Reference of the “Scientific Working Group on Neritic Tuna Stock Assessment (SWG)” by the SEAFDEC Council during its 47th Meeting in 2015, SEAFDEC implemented a series of activities to obtain better understanding on the status of important neritic tuna resources in the region, starting with stock assessment of neritic tuna species, focusing on the longtail tuna (*Thunnus tonggol*) and kawakawa (*Euthynnus affinis*). Results of the stock assessment were reported to the 50th Meeting of the SEAFDEC Council and the 25th Meeting of ASEAN Sectoral Working Group on Fisheries (ASWGF) in 2017, where the SEAFDEC Council suggested that the scientific work under SWG-Neritic Tuna should be expanded to other shared stocks of neritic tunas in the region. Thus, the Indo-Pacific king mackerel (*Scomberomorus guttatus*) and narrow-barred Spanish mackerel (*Scomberomorus commerson*) were identified for the study to be undertaken in 2018. To start the work on these two newly-identified species, the SEAFDEC Secretariat in collaboration with MFRDMD and TD organized a “Practical Workshop on Stock Assessment of Indo-Pacific King Mackerel and Narrow-barred Spanish Mackerel in the Southeast Asian Waters” on 16-20 July 2018 with the aim of transferring the knowledge from the conduct of the regional study on stock assessment for the longtail tuna and kawakawa to the scientists of the AMSs for the conduct of stock assessment for Indo-Pacific king mackerel and narrow-barred Spanish mackerel. The Workshop was attended by representatives from Cambodia, Malaysia, Myanmar, Thailand, and Viet Nam. Standardization of stock assessment analysis for neritic tunas in Southeast Asia using the software on CPUE standardization, *e.g.* ASPIC and Kobe plot, and Risk Assessment, was facilitated through the Workshop.



The Practical Workshop on Stock Assessment of Indo-Pacific King Mackerel and Narrow-barred Spanish Mackerel in the Southeast Asian Waters (16-20 July 2018, Samut Prakan, Thailand)

Conservation and management of Indo-Pacific mackerels

Indo-Pacific mackerels are another important species group that are transboundary resources and shared by many countries in the Southeast Asian region. Initiatives were also undertaken by SEAFDEC in 2018 to obtain better understanding of the status of the species, and come up with appropriate management measures for the concerned countries, particularly through the sub-regional cooperation among the countries in the Gulf of Thailand Sub-region, *i.e.* Cambodia, Malaysia, Thailand, and Viet Nam. Through the series of consultations among the participating countries in 2016-2017, it was agreed that a DNA Study on the Indo-Pacific Mackerel in the Gulf of Thailand Sub-region should be conducted in 2018 to provide knowledge on the genetic structure and population of this species. Following-up to this recommendation, the study was conducted, the results of which were discussed during the two-day “Technical Meeting on Management of Transboundary

Species: Indo-Pacific Mackerel in the Gulf of Thailand” from 19 to 20 December 2018 in Bangkok, Thailand. In addition to the discussion on the results of the DNA Study, the Meeting also established the way forward for the development of joint management plan for Indo-Pacific mackerels in the Gulf of Thailand Sub-region to ensure the sustainability of the resources based on the available scientific evidence.



The Technical Meeting of Transboundary Species: Indo-Pacific Mackerel (19-20 December 2018, Bangkok, Thailand)

1.7 Capacity building towards sustainable fisheries

Human Resources Development for Sustainable Fisheries

In support of the capacity building efforts of SEAFDEC towards sustainable fisheries, TD continued to implement the project “**Human Resources Development (HRD) for Sustainable Fisheries**” in 2018 with the conduct of a series of regional, national and on-site training courses in Myanmar, Cambodia, Lao PDR, and Thailand on the application of the Ecosystem Approach to Fisheries Management (EAFM) and fisheries extension methodologies toward sustainable fisheries development. Starting in 2016, the project activities were adjusted towards the application of the transferred knowledge in pilot learning sites to improve the incomes of fishers and establish fisheries management plans for the respective sites. In 2018, activities were undertaken in the pilot learning sites in Thailand, Myanmar, and Cambodia; while the activities for the pilot learning site in Lao PDR are planned for 2019.

In Thailand, the “Training Course on Sustainable Fisheries Management” was organized by TD on 14-18 May 2018 in Surat Thani Province. Participated by participants from the Department of Fisheries (DOF) of Thailand who have been involved in developing and promoting fisheries management plans, the Training focused on subjects such as holistic approach to fisheries management, reduction and management of conflicts among stakeholders, and so on. From the Training, nine participants were identified to serve as trainers on the subject and participated in the subsequent “Training of Trainers for Sustainable Fisheries Management” organized on 5-7 June 2018 in Bangkok, Thailand. While obtaining better understanding of the sustainable fisheries management, the participants had also been equipped with the capacity to organize similar training sessions using the various approaches to support future training in their respective countries.



*Training Course on Sustainable Fisheries Management
(14-18 May 2018, Surat Thani Province, Thailand)*



Training of Trainers for Sustainable Fisheries Management (5-7 June 2018, Bangkok, Thailand)

For Myanmar, the activities in 2018 continued to focus on improving the incomes of fishers through responsible and sustainable fisheries being promoted by SEAFDEC in Thahton Township, Mon State, Myanmar. The results of the “Workshop on Development of the Fisheries Management Plan” organized by TD in 2017 for participants from Myanmar, provided an opportunity for the participants to observe and gain knowledge on mud crab culture in Thailand that they could adapt in the country and help increase the incomes of fishers. After the site visit to Thailand, TD carried out the activity as a part of its fisheries extension work, at the pilot site in Thahton Township in 2018 on two occasions, *i.e.* 6-10 May and 24-26 September 2018.

As for Cambodia, the pilot site was in the Prek Thnot Commune, Teok Chhou District, Kampot Province, where TD organized the “Training-Workshop on the Development of Fisheries Management Plan” during 4-7 September 2018 in Rayong Province, Thailand for fisheries officers and fishers from Cambodia. The Training-Workshop was aimed at strengthening the participants’ understanding of the process of developing fisheries management plan and providing capacity building on the existing methods to increase the incomes of the fishing communities.



Activities in pilot-learning sites in Thahton Township, Mon State, Myanmar



Training-Workshop on the Development of Fisheries Management Plan for fisheries officers from Cambodia (4-7 September 2018, Rayong Province, Thailand)

HRD for Enhancing Coastal Community Resilience for Muslim Communities

During 2016-2017, MFRDMD implemented the project **“Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management”** 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. Specifically, the Project has enhanced the capacity and capability of fishers and women in the fishing community to improve their social well-being and contribute to poverty alleviation; and built the capacity of fishing communities to engage in sustainable livelihoods and improve coastal resource management. With the Muslim communities in the region’s coastal areas, particularly the countries with the highest Muslim populations as the target beneficiaries, the Project was implemented in Brunei Darussalam, Indonesia and Malaysia.

In 2017, MFRDMD carried out seven capacity building activities for related fisheries associations in the three countries involving more than 300 participants. Moreover, 11 capacity building activities were also conducted for coastal communities involving 283 participants. To conclude this project, the “Terminal Regional Technical Consultation on Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management” was conducted on 20-22 March 2018 in Brunei Darussalam, and was attended by the representatives and community leaders from Brunei Darussalam, Indonesia, Malaysia, Cambodia, Philippines, Thailand, Viet Nam, and officers from MFRDMD.



Terminal Regional Technical Consultation on Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management (20-22 March 2018, Brunei Darussalam)

Although this project was originally scheduled for completion in 2017, but due to some technical problems, the proposed activities could not be completed by 2017. The project was therefore extended to 2018 with the conduct of five (5) capacity building activities, *i.e.* mud crab culture in cages training; seafood processing training; and a series of capacity development training on seafood processing.

Specifically for the training on mud crab culture, the training was conducted on 24-25 April 2018 at Brunei Muara River, Brunei Darussalam with four (4) participants attended in this training. After the training, participants were able to identify and analyze the suitability of sites for mud crab culture in cages using relevant instruments for measuring water temperature, pH, Iron (Fe), and salinity. Participants also gained knowledge on mud crab culture to promote and enhance the socio-economic status of their coastal communities.



Training on mud crab culture in cages in Brunei Darussalam

For the training on seafood processing, the training was conducted in collaboration with Terengganu State Fisheries Department on 13-15 May 2018 at the Extension and Fisheries Technology Center, Seberang Takir, Terengganu. There were 14 participants, two of which are DOF Officers, involved in this training. During the training, the participants were trained on the importance of producing safe and good fisheries products. All trained participants were able to learn the theory and practice on processing of seafood products, namely: fish ball, fish cake, fish nugget, 'keropok lekor,' modern and traditional fish 'sata' and snow fish.



Training on seafood processing in Brunei Darussalam

As for the Capacity Development Training on Seafood Processing, there were three (3) training programs conducted by the participants that were previously trained by the seafood processing training in Terengganu, Malaysia. The trainings were conducted at: 1) Pusat Aktiviti Pelancong MPK Sungai Bunga MPK on 4-5 July 2018, by trained members from Sg Bunga; 2) Secondary School Hall, Tutong District on 6-8 July 2018, by trained members from MPK Penabai Kuala Tutong and Sg Teraban; and 3) Department of Fisheries Brunei Darussalam on 11-12 July 2018, by trained members from MPK Masjid Lama, Pekan Muara, Sabun and Pelumpang. There were 85 participants, two of which are DOF officers, involved in the training. During the training, the trained participants that previously trained in Terengganu, Malaysia were able to serve as trainers for their own respective communities; and new seafood products were introduced to communities in Brunei Darussalam.



Three series training on seafood processing in Brunei Darussalam

The project was able to attain significant involvement of the fisheries organizations and stakeholders, particularly the Muslim fishing communities in the Southeast Asian region in the planning and undertaking of activities on sustainable livelihood and coastal resource management; enhanced not only of the standard of living of coastal communities, but also food security and job opportunities as well as strengthened the stakeholders' initiatives to protect and conserve the coastal environment. Furthermore, this project also gave a positive impact on the coastal communities to have new alternative livelihood opportunities after acquiring skills from the various training programs conducted under this project.

For the way forward for participating communities under this project, program of activities, *i.e.* for development, environment management, and ecotourism development, have been summarized. This is with a view to commercializing quality fish and fishery products; establish one-stop-center for repairing fishing net, engine and fiberglass boats; develop alternative livelihood such as ecotourism; and enhance sustainable fisheries management.

Tailor-made Training Programs

TD also provided support to the human resources development activities of SEAFDEC through its **“Tailor-made Training Programs,”** where training could be designed and conducted based on the specific requirements of requesting agencies and countries. The first tailor-made training in 2018 was the “Pilot Project on Capacity Building of Thai Crews for Fishing Vessels” organized from 11 March to 2 April 2018 at TD premises in Samut Prakan, Thailand upon the request of the National Farmer Council of Thailand in collaboration with the DOF Thailand, Thai Fisheries Association, Ministry of Labor, Marine Department, Internal Security Affairs Bureau, and the Naval Operations Department. Attended by fifteen participants, the training was designed to develop the participants’ understanding, capacity, and skills on fishing operations for them to be able to work as crew onboard fishing vessels in the future. The training also enhanced the participants’ knowledge on fishing gears and operations, safety at sea, fishery and labor laws, as well as gave them the opportunity to undertake fishing operation practices at sea.

Subsequently, TD conducted the “Short-term Training Course on Ecosystem Approach to Fisheries Management (EAFM) for University Students” on 12-22 June 2018 at the TD premises in Samut Prakan, Thailand. Attended by 30 students from universities in Thailand and Japan, the Training was aimed at: 1) extending knowledge and better understanding on the concepts and principles of EAFM, basic fisheries and oceanographic surveys, and small-scale fishing gears; 2) providing experiences in assembling fishing gears for them to carry out during onboard practices; 3) giving the students opportunities to get involved with the way of life in fishing communities around the coastal areas; and 4) building up the network among students from different universities as well as strengthening their attitudes towards the teamwork approach.

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

2.1 Development of fish health management strategies

Reinforcement and Optimization of Fish Health Management and the Effective Dissemination in the Southeast Asian Region

Fish health management practices significantly affect product quality as well as quantity. This links to the economic stability of fish farmers and their communities, which is one of AQD’s main goals. To reach this goal, the project with funding support from the Japanese Trust Fund (JTF) is being implemented by AQD with the objectives of developing and accelerating rapid and effective fish and shrimp health management, enhancing the efficacy of vaccine treatment in tropical cultured species, establishing protective measures against persistent and emerging parasitic diseases of tropical fish, identifying the risk factors and developing protective measures against Early Mortality Syndrome (EMS), and extending and demonstrating the technology to practitioners and officers of the SEAFDEC Member Countries.



Optimization of q-PCR protocols: (A) Preparation of Master Mix with SYBR Fast q-PCR Master Mix (KAPABiosystems, USA); (B) Amplification carried out in Corbett Rotor-Gene 6000 Real-Time Rotary Analyzer (Corbett, Australia); and (C) Amplification program patterned from Optimized conventional PCR protocol

Viral and bacterial diseases have caused major constraints in shrimp farming in most Asian countries and in the world. The continued occurrence of the most devastating viral disease in shrimps, such as the white spot syndrome virus (WSSV) and other pathogens such as VP_{AHPND} that cause acute hepatopancreatic necrosis disease (AHPND), necessitates the establishment of domesticated shrimp stocks that are free from these pathogens. Early detection is the most efficient response to be able to implement immediate and appropriate interventions to stop the spread of infections. Prompt diagnosis gives the fish and shrimp farmers better health management measures for their stocks which in turn minimizes losses due to diseases. To attain such objective, the study on the development and acceleration of rapid and effective fish and shrimp health management was initiated in 2018.

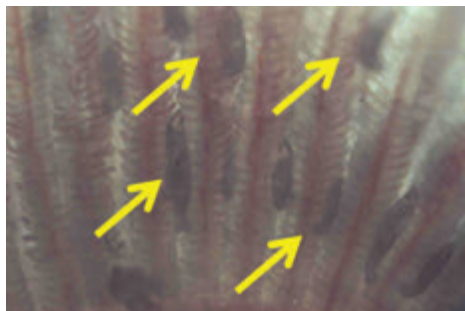
The Project activities include detection of the threshold infection levels for WSSV, AHPND and viral nervous necrosis (VNN) at different ages and weight ranges as well as development of optimized q-PCR protocols for the detection of AHPND. Results of the activities in 2018 led to the establishment of the standard curve using WSSV plasmid, with the load of the viral stock determined at 1.6×10^7 copies/g. The viral load from natural infection was also measured and resulted to one-step positive tissues ranging from 3.2×10^9 to 5.1×10^{10} copies/g while the range for the nested positive tissues were from 7.4×10^3 to 1.2×10^5 copies/g. In the artificial infection using time-course experiment, the one-step positive tissues range from 1.2 to 5.1×10^9 copies/g while the range for nested is from 3.3 to 9.3×10^6 copies/g. In the threshold level of infection for WSSV from 10^5 to 10^7 copies/g, mortality is not yet observed. The results also show that threshold level of infection for WSSV is not weight dependent. It should be noted, however, that clinical signs of WSSV such as white spot were not observed in the artificial infection experiment. The q-PCR protocol optimized in JTF 5 has proven to be successful and can be used for diagnostic purposes.

A study enhancing the efficacy of vaccine treatment in tropical cultured species was also conducted with two target commodities: (1) fish and (2) shrimp. The objective of the first target is to examine the field efficacy of the formalin-inactivated nervous necrosis virus (NNV) vaccine in high value marine fishes, e.g. groupers, sea bass, pompano, in the Southeast Asian countries where there have been serious cases or outbreaks of VNN. Grouper juveniles that were intraperitoneally injected with $100 \mu\text{l}$ of inactivated NNV vaccine (pre-inactivation titer: $10^{9.2}$ TCID₅₀/ml) exhibited neutralizing antibody titers from day 30 (mean titer $1:1792 \pm 701$) to day 150 ($1:704 \pm 351$) with the highest titer observed at day 60 ($1:6656 \pm 3435$) post-vaccination. Since no mortality occurred in both vaccinated and

unvaccinated fish during the course of the pond experiment, day 30 post-vaccinated (n=20; MBW: 21.0 ± 3.4 g) and L15-injected/control (n=20; 20.6 ± 1.0 g) fish were intramuscularly challenged with NNV (10^{6.5} TCID₅₀/fish). Nil and 25% mortality were respectively obtained in both vaccinated and unvaccinated fish. NNV titers in the brains and kidneys of dead unvaccinated fish ranged from 10^{10.9~10^{11.4}} TCID₅₀/g and 10^{8~10^{8.9}} TCID₅₀/g, respectively. On the contrary, NNV was not detected in the brains and kidneys of any vaccinated fish examined. Additionally, NNV-challenge of day 120 vaccinated (n=20; 178 ± 27 g) and L15-injected/control (n=20; 176 ± 19 g) fish likewise resulted in nil mortality, suggesting an age or weight dependent susceptibility to NNV.

The second target aims to develop a vaccination scheme using a combination of the two antiviral treatments (rVP28 vaccination and rVP28 RNAi treatment) and a low-cost delivery protocol for the antiviral treatments in tanks. A low-cost, bacterially-expressed production method was used to produce dsRNA, where the efficacy of dsRNA was tested in several challenge experiments using various doses, different frequency of administration, and inclusion of heterologous dsRNA to test the specificity of gene silencing. The best treatment was determined at a dose of 20 µg/shrimp administered four times over 28 days (two times before and two times after challenge (total = 80 µg/shrimp)), while the silencing was found specific to VP28 dsRNA. In 2018, production of rVP28 and dsRNA and determination of their encapsulation efficiency and yield in chitosan and alginate microparticles were conducted. The oral delivery using different ratios of dsRNA to rVP28 entrapped in microparticle carriers will be tested through challenge experiments in tanks.

The efficacy of orally administered garlic (*Allium sativum*) extract in powder form against *Trichodina* sp. in Nile tilapia (*Oreochromis niloticus*) and with sea lice (*Caligus* sp.) in pompano (*Trachinotus blochii*) were tested and assessed.



Trichodina sp. parasites
in gills of pompano

Oral treatments using allicin powder-supplemented diet (1.25, 2.50, 3.75 and 5.00 g/kg) and a control diet without allicin were tested on tilapia infected with *Trichodina* sp. for 14 days. Results showed that tilapia fed with allicin powder supplemented diets showed reduced prevalence and mean intensity of *Trichodina* sp. parasites compared to the control. Preliminary static bioassay to determine the 96-h LC₅₀ value of garlic extract in pompano was also carried out. The results indicated that the 96-h median lethal concentration (LC₅₀) of allicin

powder to pompano for 24, 48, 72 and 96 hour of exposure were 29.18, 23.31, 16.79 and 6.64 mg/L respectively, while the histopathological analysis is currently ongoing.

An experiment was also conducted to clarify efficiency of greenwater system using siganids, *Siganus guttatus* (SGW) against AHPND in shrimps. Using a simulated tank experiment, infected shrimps were cultured in SGW and non-SGW simulated environment using fiberglass tank with soil, shrimp survival was higher in SGW (46%) compared to non-SGW (24%). Bigger shrimp were harvested in SGW (ABW=3.90 g, n=58) than in non-SGW (ABW= 1.73; n=58).

Shrimps from SGW harbored less *Vibrio parahaemolyticus* (1.2×10^4 cfu/hepatopancreas) compared to those from non-SGW (4.95×10^5 cfu/hepato). The results suggest that SGW provides protection against VP_{AHPND} and thus could be used to culture shrimps.

Technology extension and demonstration are important for effective and functional development of fish health management that guarantees sustainable development of aquatic food production for poverty alleviation in the Southeast Asian countries. Training programs are implemented by AQD on specific topics based on requests from the Member Countries necessitating information on fish health management. Not only are the knowledge and technologies delivered, but also follow-up surveys are carried out to facilitate dissemination so that information effectively reach the aquaculture farmers, fish health managers, LGU officers, to name a few. Through this JTF project, AQD is coordinating with respective SEAFDEC Member Countries for any practical training course that they might need.

2.2 Establish and promote responsible management of natural resources

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

With support from the JTF, AQD has been continuously trying to contribute to food security and poverty alleviation, and to reach such goal, this Project is being conducted to establish environment-friendly and responsible aquaculture technology; promote community-based production and resource enhancement of high-value aquatic resources necessary to secure the livelihood of fishers while avoiding rampant, illegal fishing and social conflicts; and extend and demonstrate aquaculture technologies to the Member Countries.

In order to achieve the first objective, two sub-activities have been carried out: (1) promotion of plant-origin feed ingredients and (2) responsible aquaculture through aquasilviculture. A study on the use of plant-based protein sources in tilapia feeds was conducted to produce tilapia with improved production traits using agricultural wastes and by-products (ABPs) as feed ingredients. In 2018, feeding trials were conducted to evaluate the suitability of ABPs in diets for tilapia broodstock and fingerlings.



*Bacterial treatment of selected agricultural wastes and by-products (ABPs) with *Bacillus subtilis* is explored to improve their nutritional composition*

By replacing fishmeal with 50% mango peel silage diet, fry production had increased but resulted in slightly reduced growth of tilapia breeders over the 51-week period in tank- and lake-based cages. Okara meal as fishmeal replacer at 30% inclusion level enhanced the growth and feed utilization in tilapia fingerlings. Citrus by-products (citrus peel and citrus pulp) as feed additives should be supplemented at 1% of the diet to achieve best growth performance in Nile tilapia fingerlings. Dietary inclusion of fermented okara meal up to 15% had no adverse effects on the growth and feed efficiency, and was found effective at maintaining the acceptable sensory attributes such as texture and flavor of fish flesh.



Set-up for the tilapia feeding experiment (left) and Nile tilapia fingerlings fed fermented okara meal (right)

On aquasilviculture, experiments were conducted to determine the time required for mangrove habitat to remove nutrients, *e.g.* nitrogen and phosphorus from shrimp farm effluents. Results showed that at mangrove-to-pond area ratio (MPR) of 4, ammonia was removed from the water after 3 days; total suspended solids (TSS) in two days; phosphate and chlorophyll in seven days. At MPR = 2, only ammonia could be efficiently removed after three days. Levels in MPR = 0 remained high until after 14 days. Mangroves purify the water by nutrient uptake as indicated by the greater increase in stem length of saplings and trees in areas receiving compared to habitat not receiving the shrimp farm effluents.

The second objective also addressed two activities: (1) community-based integrated production of abalone *Haliotis asinina* and sandfish *Holothuria scabra*, and (2) resource enhancement of seahorses. The first activity aims to improve fisheries governance and management strategies for enhanced abalone and sandfish stocks and its healthy habitat. In 2018, an abalone hatchery was constructed in Molocaboc Island in Sagay, Negros Occidental, Philippines which is used for fisherfolk training. Meanwhile, the releases and monthly monitoring of abalone and sandfish stocks and its replication in another nearby island (*Diut*) was continued. Freeze-drying trials for abalone to explore marketing options was also tried. The project also proven its replicability as communication between AQD and Partido State University in Camarines Sur in Bicol Region is ongoing for possible replication of the project.

Promotion of resource enhancement of seahorses is the focus of the second activity, to determine the appropriate time of release, growth and survival of the released seahorses; promote the involvement of the community in the management of the natural resources; and establish a community-based hatchery for seahorses. The uncertain availability of juvenile seahorses from the AQD hatchery led to the conduct of trials to establish nursery rearing techniques of seahorses in Molocaboc Island using available food from the sampling site. Many challenges encountered had been mitigated by installing additional solar power system and training of the fishermen's organization members on the nursery rearing of newborn

seahorses. Trials on the acclimation of juvenile seahorses are currently conducted in hanging net cages prior to their release in the pilot site. Information, education and communication activities were conducted to promote the conservation and protection of seahorses through the conduct of lectures in schools, distribution of posters, and conduct of interviews with the local community.

One of the most important missions of AQD is to transfer the latest technologies and information on aquaculture to the ASEAN Member States through training courses. Two training programs: *Marine Fish Hatchery Training Program* and *Rural Aquaculture Program* were carried out under JTF6. The training on marine fish hatchery which includes breeding, hatchery and seed production, nutrition and health management of grouper, sea bass, and snapper, was conducted in 2018 with 16 participants, four of whom received funding through the JTF. The rural aquaculture program includes a 10-day training focusing on the promotion of community-based freshwater aquaculture for remote rural areas of Southeast Asia, which was conducted before the end of 2018 at AQD's Binangonan Freshwater Station.

2.3 Improvement of broodstock and seed production technologies

Quality seed for sustainable aquaculture

A sustainable supply of good quality seedstock is key to a successful aquaculture enterprise. Rearing quality seedstock to commercial sizes require efficient husbandry techniques and suitable farm conditions to achieve increased yield. With the intensification of aquaculture systems in several Southeast Asian countries and the environmental challenges such as those resulting from climate change, both factors – genetic quality and culture management, are equally important in ensuring a steady production of good quality seeds and later, marketable aquaculture products. In 2018, AQD continued to generate, verify and promote technologies to ensure the sustainable production of quality seedstock for aquaculture as well as for stock enhancement.

o Developing good quality broodstock

To achieve the main objective of developing and managing quality broodstock for use in either commercial fish farming and/or stock re-population, stock characterization using molecular markers are utilized to aid in determining genetic quality in hatchery stocks. In spite the availability of established technologies for abalone aquaculture, the steady growth of the Philippine abalone industry is limited due to inadequate information on the sources of good quality breeders and seedstock. A study was therefore carried out by AQD to generate a preliminary database on possible sources of genetically diverse abalone *Haliotis asinina* stocks for broodstock development. One hatchery-bred stock (HB) and nine wildbred stocks – Masbate (MS), Palawan (PA), Pangasinan (PN), Cebu (CE), Sagay (SY), Zamboanga del Sur (ZS), Agusan del Norte (AN), Surigao del Sur (SS), and Dinagat Island (DI) were obtained and analyzed using six novel short tandem repeat markers. Seven (MS, PA, PN, HB, CE, SY and ZS) of these founder stocks were used to produce F_1 batches (mainly families) that were later assessed for genetic variability and growth performance. Mean expected heterozygosities (H_e) in the founder stocks ranged from 0.76 to 0.90 where the highest was the PA or Palawan stock and the lowest was the ZS stock from Zamboanga del Sur followed by SY from Sagay at 0.79. Results from this study showed that all the stocks examined generally have moderately high to high genetic variability. Even if the PA stock showed the highest genetic variability

and survival during hatchery phase, no statistically significant stock differences were noted in all the parameters, *e.g.* genetic variability, growth and reproductive performance. This could mean that wild-sourced abalones from any of the studied sites could be used for local aquaculture. However, to maintain the genetic integrity of wild abalone populations, abalone seedstock production for re-seeding natural populations should use breeders from areas near the restocking sites. Finally, to maintain good quality in hatchery produced seedstock, regular monitoring of the growth performance should be made on the seedstock when reared in the grow out phase since the growth of hatchery-bred stocks appeared to be poor compared to those bred from newly-acquired wild parents. As such, broodstock management through replenishment or replacement of breeders should be made when growth performance is noted to decline.

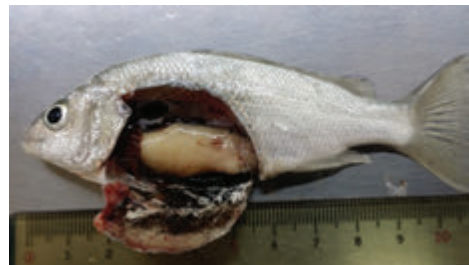
In previous studies on abalone given formulated diets with varying ratios of protein and energy levels, the broodstock had shown markedly improved fecundity, length of conditioning period, spawning frequency, and egg hatchability when given the diets at higher protein and energy level ratios (up to 42% protein/3750 kcal kg⁻¹ energy) compared to those given natural food (18% protein/2200 kcal kg⁻¹ energy). However, the effect of the formulated diets on larval competency in terms of settlement success and post-larval survivorship has not been monitored. The study in 2018 is therefore aimed at verifying the two best performing diets (protein/energy level ratios of 37% /3570 kcal kg⁻¹ and 42% /3750 kcal kg⁻¹) on a longer period involving higher number of animals to determine whether further refinements are necessary or if the diets are ready for commercial application. In addition, monitoring of the parameters for larval quality including larval growth, development and survival would also be carried out to complete the existing information. Potential broodstock from Palawan (PA) and Sagay in Negros Occidental (SY) are being grown to reach mean SL of five-six cm, to be used in the verification study. These will be conditioned for two months until these are ready to spawn. Feed ingredients have been procured and will be prepared two weeks before the feeding trials while gonad maturation will be monitored and the breeding performance as well as larval quality will be evaluated.

Genetic characterization of mangrove crab *Scylla serrata* stocks based on three novel and three existing short tandem repeat (STR) markers was also carried out to maintain high genetic variability and to check for the negative impacts of domestication in several generations of selected and control stocks from Camarines and Surigao. Thus far, raw 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 number of alleles, respectively while two batches of the first generation Camarines control stocks had lower alleles at 6.67 and 6.50, respectively, and one batch of the first generation Surigao control stock had *A* = 6.33. Slightly lower *A* estimates were noted in the first generation selected stocks from Camarines (6.17 and 6.50) and Surigao (4.0). Expected heterozygosity estimates were not significantly different between the stocks and across generations based on the existing batches that were screened. Molecular marker data were correlated with the parameters for selected beneficial traits to determine if the markers could be used as preliminary indicators of genetic improvement. Collection of the last batch of samples from parental, selected, and control batches was completed in 2017. The results of this study, which was extended until the middle of 2018, are currently being consolidated in an article for submission to a scientific journal.

A study of the Philippine native *Clariid* catfishes (mainly *Clariid macrocephalus* and *C. batrachus*) that focuses on broodstock development and management was initiated in 2018.

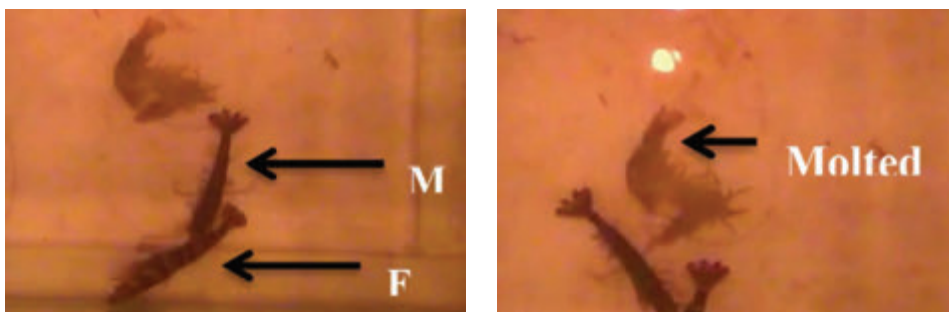
Renewed interest of stakeholders on the propagation of the native catfishes is due to the fact that these commodities are disease resistant, can be stocked at high densities, and thrive in areas where water quality is not optimal. As such, the native catfish could be an ideal culture species especially at times when climate change seems to pose numerous challenges to freshwater fish farming. In 2018, stocks from Zambales, Quezon, and Iloilo, were collected for broodstock development and broodstock diet experiments. The stocks were maintained and bred through induced spawning to comprise the founder stocks. Offspring with known ages produced from each stock are now being reared for stock evaluation in 2019 and comparison by looking at possible differences in breeding efficiency and response to broodstock diets. The broodstock diets that have been tested initially on the Zambales founder stocks contained 0.5% mango peel, 0.5% paprika and a combination of both. Preliminary results using mature *C. batrachus* from Iba, Zambales showed higher relative fecundity (28.3 and 28.6 eggs/g body weight in female, respectively) from those given feeds containing either 0.5% mango peel or the combination of mango peel and paprika. However, hatching rate was noted to be higher (86.3%) in the treatment fed the diet with paprika alone.

In the study on the reproductive performance of captive silver therapon (*Leiopotherapon plumbeus*) broodstock, three broodstock diets with varying levels of dietary protein (30% or 30CP; 40% or 40CP; and 50% or 50CP) were formulated to examine the effect of artificial diets on the broodstock. Another set up was established to assess the performance of captive broodstock fed test diet with 50CP and reared in a biofloc technology (BFT) condition. Broodstock diets were supplemented with dried earthworm meal at 4-12 g/100 g diet. The initial results have shown that all females in the 40CP and 50CP groups spawned, whereas only 89% and 78% of females spawned in the BFT for 50CP and 30CP groups. Gonadosomatic index (GSI) was highest in female broodstock in the 50CP group (12.53), but were comparable with other treatment groups. Male broodstock in the 40CP group showed the highest GSI (9.48) among all the treatment groups. Relative fecundity (313-390 eggs per gram female), fertilization (68-75%) and hatching rates (48-90%) increased with increasing dietary protein level. High larval production (418-421 larvae per gram female) was observed in the 40CP and 50CP groups.



Effect of dietary protein levels on growth, fecundity and egg quality in female silver therapon broodstock

For better understanding of the conditions that encourage and facilitate mating in the tiger shrimp *Penaeus monodon*, experiments that aim to determine the differences and problems in breeding performance of male and female spawners from captive and wild environments – stocked separately and/or their combination as mates – were conducted. Video documentation was made on the reproductive behavior, including the pursuit of females by males and vice versa, and number of mating episodes of adult *P. monodon* during trials separately exposing spawners to varying depth and temperature. From the video recordings, wild males were observed to spend more time near wild females compared to captive female broodstock. Likewise, wild male pursued the molted female broodstock more frequently compared to the captive males. In terms of molting time and duration of the female shrimp to exit the molt, wild female shrimp was observed to molt earlier compared to captive shrimp. The recorded time, in seconds, in which the females exit the molt was similar for both wild and captive females. The male shrimp touched the discarded female molt shell or stayed within the area of the molt shell for some time. In some of the video recordings, it can be seen that the male shrimp ate the female molted shell or the male killed or ate the newly-molted female. Molting was not observed in the captive female and wild male combination and mating was not observed for the different trial combinations. Histological and gonad morphology evaluation of the captive and wild male breeders indicated that the gonad of wild male is slightly opaque white in color compared to that of the captive male, which is translucent in color. The experiment using a hormone methyl farnesoate to induce female crustacean molting and reproduction, will be continued in 2019.



Wild male (M) chasing molted wild female (F) shrimp

Activities were implemented in 2018 on the development of technologies for giant grouper aquaculture. Giant groupers have been observed to directly undergo male sexual maturity contrary to the general idea that groupers are protogynous hermaphrodites wherein all individuals mature first as female and then reverse to male. Furthermore, females were noted to mature at 22-25 kg body weight (BW) and 95-99 cm total length (TL) while males mature at 15-20 kg BW and 81-92 cm TL. The reproductive cycle of giant groupers peaks during full moon, thus, induced spawning activity is best performed at this time. Spontaneous spawning of giant groupers in the floating sea cage was achieved through hormonal manipulation using slow-release Gonadotropin-releasing hormone (GnRH) implant and human chorionic gonadotropin (hCG) injection but fertilization rates have been highly variable. Treatment with hCG (500 IU/kg BW) was not effective for induced spawning of the giant groupers. Spermiation was induced in males through treatment of hCG (1000 IU/kg BW) although better results could be obtained when slow release GnRH pellet (60-80µg/kg BW) was implanted 48 hours prior to hCG treatment. For females, GnRH treatment alone is effective in inducing final oocyte maturation and ovulation. Hence, timing of GnRH and hCG treatment can be modified

between the two sexes so that final maturation of female and male gamete would occur at the same time, either for spontaneous spawning or stripping and artificial fertilization.

This study likewise looked at the appropriate larval food for giant groupers. Inclusion of the rotifer *Proales* during the first 10 days of rearing results in significantly higher larval survival rate. Recently, giant grouper larvae were reared in three-ton circular tanks and *Proales*-supplement was given starting day 1 and *Brachionus* was fed on day 2 and onwards. Spines were observed at day 16, however, only the shooters metamorphosed to juvenile stage. Given *Proales*' benthic nature, the increased frequency of direct feeding and the utilization of dripping method yielded successful rearing (day 35 survival rate: 0.3%) compared to the trials previously done in giant groupers with no survival at day 35. As of December 2018, the three-month-old giant groupers have been stocked in one-ton fiberglass tank at AQD's Marine Finfish Hatchery.

Another component of the study is focused on sperm cryopreservation to prolong the viability of grouper sperm through cryopreservation in liquid nitrogen or in a -80°C biofreezer. In terms of motility, the tiger grouper sperm is better retained in cryopreserved sperm while long-term fertilization capacity was only confirmed in giant groupers. Generally, viability remains despite a total loss in sperm motility. Initial results in evaluating the suitability of Ficoll 70 as additive to the MPRS-DMSO (9:1 v/v) sperm extender at -80°C storage showed a dose-dependent effect in terms of preserving viability. However, addition of Ficoll 70 does not positively affect motility conservation, which only lasted up to one month of cryopreservation. Further trials tested the effects of the extender pH (5.0, 6.0, 7.0, 8.0) on sperm motility for sperms stored at 4°C . For giant groupers, highest motility was observed in the treatment with pH 7 followed by pH 6. A 15-day refrigerated storage was the maximum duration resulting in observable motility.

Identification of the critical stage during early development of *Marphysa mossambica* was carried out in 2018 by refining the rearing and feeding techniques for its mass production. A significant decrease in the survival of the polychaetes after 45 days of rearing indicated that the extension of rearing period on biofloc from one month to another 15 days is no longer favorable. At this period, it is probable that polychaetes already need suitable substrate (mud) and food (formulated diet) for further development until reaching the adult stage. This is therefore a critical stage for the polychaetes as it is a transition period from early juvenile to juvenile stage. Moreover, the egg hatchability and larval development of *M. mossambica* subjected to varying irradiance and photoperiod treatments have also been investigated. Results showed that survival of polychaetes were significantly low in one-hour, three-hour, six-hour photoperiods of 747 lux and 1,747 lux compared to no light treatment. The no light treatment had the highest survival but statistically similar to the three-hour and six-hour photoperiods of 42 lux light intensity. In determining their optimum stocking density and sediment depth requirement during their nursery and grow-out phases, polychaetes were stocked at densities of 20 (10,000/m²), 40 (20,000/m²), 30 (30,000/m²), and 80 (40,000/m²) individuals per container with four replicates, each containing 200 ml of seawater. Replicate containers of each treatment were added with one gram biofloc (fresh) at the start of the experiment. Although not significant, the survival of *Marphysa* sp. declined sharply at a stocking density of 40,000 trochophores/m² (18 + 3%). In terms of growth, density of 10,000 trochophores/m² gave the highest number of segments (21 + 1) than the other stocking density treatments ($P < 0.05$).

o *Refining hatchery and nursery management protocols to improve seedstock production*

The feasibility of nursing Philippine native glass eels in captivity was initiated by AQD in late 2017 and continued in 2018, while the appropriate rearing protocol of this fish species is being developed by providing suitable feeding scheme and/or formulated diets for nursing the glass eels and young elvers. Moreover, identification of anguillid eels based on morphological and genetic characterization and potential pathogens in nursery eel systems was also carried out.

In the initial feeding trials of glass eel samples from Aparri, Cagayan, conducted for 24 weeks with six treatments (**Table 1**), results showed that the glass eels in Treatment II had the highest weight gain of 3,679% and survival was also highest at 77%. The lowest survival was observed in Treatment III at 2%, while glass eels in Treatment IV did not survive beyond week 16.

Table 1. Diet used in initial feeding trials of glass eel samples

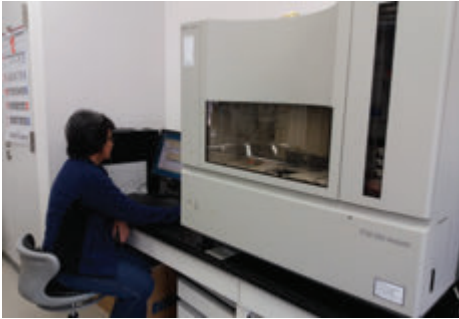
Treatment	Diet
I	<i>Artemia nauplii</i>
II	<i>Tubifex</i> sp.
III	Formulated Diet (FD; 52% crude protein [CP]; 10% crude fat [CFat])
IV	Commercial Diet (CD; 47% CP; 6% CFat)
V	FD + <i>Artemia</i>
VI	FD + <i>Tubifex</i>

Weaning trials were also conducted in 2018 where the glass eels (0.11-0.15 g initial body weight [BW]) from General Santos City in Mindanao were fed *Tubifex* sp. (50% BW) alone until week 2, tuna eggs (7% BW) and *Tubifex* sp. (37.5% BW) from week 2 to 8, and formulated diets (1.5 to 3% BW) and *Tubifex* sp. (from 25% to 12.5% BW) from week 8 to 22. Formulated diets were moist (Treatment I, MF), semi-moist (Treatment II, SMF) and dry feeds (Treatment III, DF). Results showed that Treatment II (SMF) had the highest weight gain of 1171%. Survival after 22 weeks of rearing was highest in Treatment III (MF) at 89% and lowest in Treatment II (SMF) with only 84%. The weaning duration was also determined by analyzing their growth in terms of final body weight, percent weight gain and specific growth rate. Results indicated that growth was significantly higher in *Tubifex*-fed glass eels (control group) compared to those gradually weaned onto paste diet for 28 and 42 days. No significant difference was observed in survival rates of eel groups gradually weaned onto paste diet and that of the control group.

Meanwhile, glass eels pre-sorted and identified as *Anguilla bicolor pacifica* from Mindanao were stocked at 1.96 individuals per liter in nine, 500-L polyethylene tanks with 250 L low saline water at 3 ppt. Glass eels were fed *Tubifex* sp. four times (0900, 1100, 1300, and 1500 h) daily at 50% of estimated body weight. *Tubifex* sp. were placed in plastic baskets which served as feeding and resting stations for the eels. After two weeks, survival rates ranged from 93.3% to 99.8%.

The stocks used for the feeding trials which came from batches of glass eels collected in 2017 and 2018 were morphologically and genetically identified. Analysis of the 2017 Aparri samples enabled the identification of 77 pieces of *Anguilla luzonensis* among the stock, aside

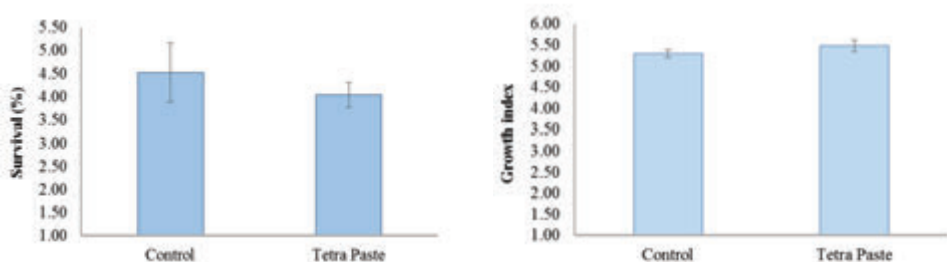
from 19 tails of *A. marmorata*. Based on *cytB* sequence alignments, the samples from General Santos City in Mindanao were composed of 95 *A. marmorata* and one *A. bicolor pacifica*. The genetic characterization and identification of the 2018 samples (comprising samples used in selected nursery farms and wild sourced eels) were carried out at the Onagawa Field Science Center of Tohoku University, Japan from 30 November to 14 December 2018. Analysis on the DNA barcoding data using *cytB* is ongoing, although another COI marker was tried but with little success. Apart from mtDNA sequence analysis, seven microsatellite primers used in Anguillid species were successfully tried on the Philippine Anguillid eel samples and the protocols for cross-amplification and microsatellite analysis were optimized.



Genetic characterization and identification of samples carried out at Onagawa Field Science Center

The glass eels and rearing water from surveyed eel nursery farms were monitored for the presence of pathogens, and bacterial analyses were conducted by making use of serial dilution and plating method. Results showed that *Trichodina* and monogenetic trematodes were found in the eel samples, of which the highest prevalence of *Trichodina* was found in a Zambales farms at 90%, which also had the highest intensity as well as mean abundance. In the case of monegeneans, the incidence with 50% prevalence was found only in the Zambales farm.

For the hatchery rearing of mangrove crab seedstock, the use of algal paste in rotifer cultures for mangrove crab seed production was evaluated. Initially, *Nanochlorum* paste was used in rotifer culture but *Tetraselmis* paste proved to be a better option. Hence, further establishment of protocol for the use of *Tetraselmis* paste was done to improve the growth and density of rotifer compared to the live *Nanochlorum* batch culture. The results indicated that algal paste acclimated and activated for four hours prior to feeding to rotifers gave better results than feeding rotifers with *Tetraselmis* batch culture. An assessment comparing the commercially available algal paste used as feed to rotifers with the paste made in AQD through electrolytic flocculation of the live algae from batch culture, in terms of the performance of mangrove crab larvae fed with rotifers is being assessed.



Survival and growth of mangrove crab larvae with rotifers fed with Tetraselmis algal paste and control or Nanochlorum batch culture

On sandfish, a study to optimize hatchery production was undertaken in 2018 by making use of the review of previous production runs of sandfish under various research studies conducted by AQD were evaluated for adoption of possible interventions. So far, the methods, refined and optimized, employed for best production results were: (1) broodstock sourced from the wild; (2) use of thermal and food shock to induce spawning; (3) larval stocking density of <250/L and use of *Chaetoceros calcitrans* as larval feed; and (4) use of *Spirulina* plates as settlement cues.

Sandfish broodstocks from two sources: Concepcion, Iloilo (N=36) and Sagay, Negros Occidental (N=56) were maintained in the hatchery from January to November 2018, resulting in 14 spawning attempts for the broodstocks from Sagay and seven attempts for the Concepcion broodstocks. Target production of 20,000 early juveniles per batch was achieved in four batches, the highest being 86,536 in August. In terms of survival, larval rearing in April and August achieved >5% survival from two culture tanks, although, the average survival in April was at 2.87% and 2.70% in August. As for early juvenile production, the target of 20,000 per spawning batch was achieved by three out of six batches producing 21,000 to 34,000 juveniles per batch. However, three batches produced <12,000 attributable juveniles due to the following factors: (1) cold temperatures during the January to February; (2) low supply of larval food in April to May; and (3) high precipitation and low salinity in July to September. The Hatchery Manual on Sandfish is being updated to include the best protocols and practices, with emphasis on the protocols for determining the optimal characteristics and indicators of “good” batch from eggs to larvae. The indicators of “bad” spawning batch will also be established to guide hatchery planning and management when to discard non-optimal stocks, thus, saving on resources and optimizing the production of only “good” quality sandfish juveniles.

In a study aimed at optimizing the growth and survival of sandfish juveniles to 20 g fingerling size, rearing was divided into two nursery phases: primary nursery phase for early juveniles (<five mm to >40 mm or three g), and secondary nursery phase for late juveniles (three g to >20 g). This study also intends to determine the optimal rearing conditions for primary nursery system of early juvenile sandfish (>four mm) in tank-based floating hapas and evaluate the rearing performance of secondary nursery system for late juvenile sandfish (>40 mm) in tank-based floating hapas. The primary nursery operation carried out from September to November 2018, yielded 49-55% survival and final weights of 1.48-1.51 g at 500/hapa initial stocking density. The shading and biofilm experiments using 12 hapas, which commenced in mid-November, will be continued until 2019. For the second nursery phase, three types of supplemental feed were used: milkfish larval feed (ML), shrimp starter feed (SS), and *Sargassum* powder (SP), and a control with no supplemental feed. Three replicate bins with sediments were used for each treatment and control. The initial results during the first 30 days revealed that sandfish fed with ML had the highest growth rate at 0.09 g/d, followed by SS at 0.0 g/d. On the other hand, sandfish shrunk when fed with SS (-0.01 g/d) and sandfish dependent only on natural food with no supplemental feeding shrunk even more (0.02 g/d).

On the promotion of *Kappaphycus* culture, nursery rearing techniques have been refined including the production of young seaweed plantlets using vegetative thallus *in vitro*. Seaweeds were grown in tanks and net cages to provide continuous supply of cultivars for mariculture, where the culture condition was optimized in the laboratory and in the cages. Plantlets that were grown *in vitro*, were successfully planted in nursery nets in AQD’s Igang Marine Station. Propagules were grown in the sea-based nursery for two to three months. Plantlets were

likewise successfully out planted in Bohol, Iloilo (Concepcion and Ajuy), Guimaras (Panobolon and Sabang), Samar (Guiaun), Davao (Penaplata, Samal), Basilan (Isabela City), and Antique (Panagatan). The ultimate objective of the study is to test the performance of propagules from the nursery and estimate the cost production of plantlets in land and sea-based nursery. In 2018, about 22 batches (from a total of 24 batches with two batches mortality) were harvested from the indoor laboratory where a total of 38,420 plantlets were produced in the land-based nursery with monthly average of 3,500 individuals and average length of one cm (10 mm). For the production of propagules in sea-based nursery cages, a total of 12,113 plantlets were produced.

A study on the production of algal paste through electrolytic flocculation using important, locally available microalgal strains and/or species in aquaculture was conducted to establish the optimal conditions for production. Manipulation of the following factors in the design and operation of the flocculator was carried out: (a) current/power source; (b) salinity; and (c) the flocculator's metal component. The pastes produced were assessed in terms of viability, length of storage and metal residues that may be found in the paste.

The culture and scale up of algae was carried out for the diatom *Chaetoceros calcitrans* for mass production and subsequently for algal paste production. Results showed that *C. calcitrans* can be mass produced in four days, and in the scale up cultures to 10 L and 100 L, division rate (k) was calculated at 0.79 cells d⁻¹ and 0.75 cells d⁻¹, respectively. Highest cell counts were 4.7 x 10⁶ cells ml⁻¹ or 10 L and 1.3 x 10⁶ cells ml⁻¹ and 100 L. For flocculation, three units of variable power supply machine were fabricated, each compartment consists of a selector switch, DC ammeter and DC voltmeter enclosed in a cabinet. Several modifications were done to avoid overheating of some components, while actual voltage was determined per selector switch setting from zero to nine. One voltage setting (12V) was used and the treatments varied from the number of aluminum tubes and lead sheets used (e.g. 2-2, 4-4 and 6-6, respectively). More paste was harvested from the 6-6 combination but no significant difference was noted between treatments. For paste quality assessment, biochemical profile results for % lipid and % protein showed no significant differences between treatments. Chlorophyll content and % carbohydrates were higher in paste but were also not significantly different between treatments. Lead content was significant (605.28 ± 9.7 mg L⁻¹) in paste using 2 anode 2 cathode than in the other treatments. In terms of viable cells, there is no significant difference when using variable anode/cathode electrodes 6/6, 4/4, and 2/2.

To support the research and production activities of AQD, the Larval Food Laboratory provided the stakeholder-clients with the following amounts of larval food: (a) 21,842 liters (live) and 19.84 kg (paste) of microalgal and rotifer starters for oyster, sandfish, abalone, marine fish (grouper), annelids, *artemia* biomass, *Proales*, copepods, shrimp and mangrove crab hatcheries; and (b) 34.96 kg (wet weight) of *Artemia* biomass for the seahorse, mangrove crab, FishWorld and Marine Fish Hatchery requirements. The Laboratory also sold the following to AQD clients: (a) 1,299.4 L of liquid microalgal/rotifer/starters; (b) 200 g *Artemia* cysts; (c) 12 kg of concentrated microalgal paste; (d) 62 tube cultures; and (e) pre-mixed fertilizers and culture media 548 L (TMRL), 435.2 L (F medium), 41.7 L (Conwy medium) and 246 L (commercial fertilizer). A total of 273 paying clients comprised the following sectors: (a) private sector (local, 45.4%; foreign, 7%); (b) academe 27.8%; and (c) government institutions 19.8%.

For milkfish, the development of a protocol for transporting milkfish juveniles (with an average total length of five to six inches) from the nursery to sea cage facilities was continued in 2018, with the specific objective of defining the optimal temperature and salinity requirements for transporting milkfish juveniles. Results of the trials on the suitable conditioning period of confinement in cages and in ponds before juveniles are transported to milkfish sea cage farming sites showed that milkfish juveniles can be transported for up to 12 hours in a closed system under various salinities, temperatures and their combinations, with minimal mortalities. Conditioning for four-week period in confinement prior to juvenile transport gave the best result and the least favorable result was obtained for those conditioned for one day. When 2 phenoxy-ethanol (PE) was used as sedative during actual juvenile transport, survival did not differ among the treatments and was comparable in treatments that have 2 fish/L, 4 fish/L, 4 fish/L plus 50 ppm PE and that of 6 fish/L plus 50 ppm PE.



Packing of milkfish juveniles for transport

- o *Increasing awareness on available genetically selected and improved stocks and optimizing their use for improved on-farm aquaculture production*

Genetic improvement research initiatives of AQD with funding from the Philippine Department of Science and Technology (DOST), have been completed in 2018 on two species: abalone and mangrove crab. For the mangrove crab, production of fast growing and disease resistant lines was focused while for abalone, improvement of breeding performance through strain comparison and evaluation and other beneficial traits such as growth was carried out. Once lines and strains have been identified and are confirmed to be better, both improved strains and the protocols that were formulated for production would be documented and the stocks, if any, would be promoted for dissemination.

- o *Promoting technically and economically viable breeding and seed production schemes*

Large-scale production of abalone *H. asinina* was carried out by AQD from February to October 2018, where 13 spawning episodes were documented for abalone at the AQD Abalone Hatchery producing a total of 22 larval batches, with spawning generally occurring 12-15 days after the last spawning episode. Out of 420 conditioned females in the hatchery, 12.8±7.8 broodstocks spawn every spawning episode, giving spawning success rate (% that spawned) of 3% using seaweed *Gracilariopsis heteroclada* as food. Larval production per spawning episode was 2,482 of 806±1,788), with 764 attaining a survival rate (from trocophore to veliger stage) of 68±24%. Average fecundity is 155 (561±78) with 136 eggs per female. After four spawning episodes, the Hatchery was able to produce around 198,896 early juveniles.

Production yield and survival rate of juveniles from stocked veliger larvae was $3.11\pm 1\%$. Improved post-larval nutrition was the main contributing factor that led to increased yield of juveniles.



Mangrove crab instars produced at AQD hatcheries

For mangrove crab, production at AQD's Hatchery was also carried out with mature female broodstock producing crab instars (with 0.6-0.8 cm carapace width). The broodstock were obtained from grow-out farms in AQD's Dumangas Brackishwater Station (DBS) and in nearby Capiz Province. A total of 185 broodstock were collected with the most recent collection on 23 November 2018, and 70 of these crabs spawned. From the recorded spawnings, only 36 produced viable larvae and the remaining spawners had unfertilized eggs. A total of 615,235 crab instars were produced, from which production income generated from February to December 2018 was PHP 1,872,480.00. Buyers of crab instars were mostly from the Provinces of Iloilo, Capiz, Aklan, Negros, Masbate, Pangasinan, and Zamboanga. The current number of crab broodstock maintained in the hatchery is 53 pieces.

2.4 Ensuring food safety through sustainable aquaculture methods

Healthy and Wholesome Aquaculture

In order to attain significant improvements and sustain aquaculture production in the face of many challenges posed by present and future ecological, economic as well as climatic changes, AQD invoked strategies to promote healthy farmed aquatic animals with emphasis on nutrition; disease diagnosis, control, monitoring and surveillance of aquatic animals; and environmental integrity, certification, and food safety. The optimization and sustainability of aquaculture production shall be based on the Best Management and Good Aquaculture Practices to ensure the least impact on the environment. The two components of the Program are: (1) fish health and (2) feed and nutrition.

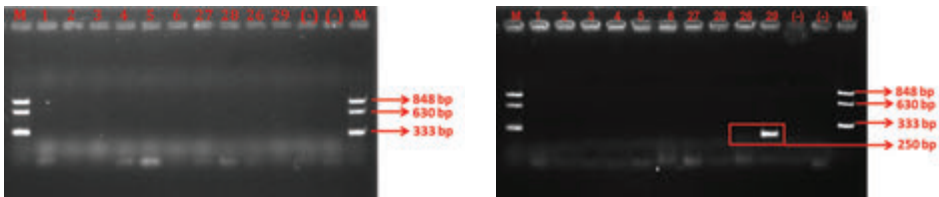
- o Promoting wider use of conventional and new diagnostic methods for new emerging diseases and biosecurity*

Tilapia Lake Virus (TiLV), an RNA virus, is an emerging disease that is becoming a serious threat to the culture of tilapia in the Asian countries. To address this concern, AQD carried out studies to detect, quantify and assess the viability of TiLV in pond soil and water influenced by water quality parameters and culture development.



Wild tilapia (O. niloticus) sampled from Laguna de Bay found to be nested PCR-positive for TiLV

Tilapia (n=123: wild and cage-cultured), soil, and water samples were collected from culture facilities in Tarlac, Pampanga, and Bata-an. Using Quantitative Reverse Transcription - Polymerase Chain Reaction (qRT-PCR) to detect and quantify the virus, results indicated that from the tilapia samples (32 *Oreochromis niloticus* and 5 *Sarotherodon* spp.) tested negative using one-step PCR but two were tested positive using nested PCR. RNA was extracted from soil using Phenol-Chloroform-Isoamyl and analysed using semi-nested PCR, and the results showed two out of four soil samples tested positive for TiLV. For water samples, RNA was extracted using QIAamp Viral RNA mini kit and processed using semi-nested PCR, resulting in all water samples tested as negative.



Result of one-step (left) and semi-nested PCR (right) for the detection of TiLV in soil, water, cultured and wild tilapia samples

Trial sampling for detection of diseases and pests in seaweeds (farmed and wild) was also conducted to produce detection and molecular diagnostic tools for proper identification of pests and diseases in seaweeds. Samples taken from Inampulugan Island in Guimaras showed that epiphytes were present in both wild and farmed seaweeds. Intensive sampling was then conducted in six sampling sites around Central and Southern Philippines, where epiphytes and *ice-ice* were observed in the collected samples. An initial batch of seaweed samples was processed for histology and a set of samples are currently undergoing electron microscopy analysis. The identified samples from trial and intensive sampling will be compiled in a central, open-access database and biobanks.



Microscopic view of an unidentified epiphyte with carpogonium (left) and unidentified epiphyte with developing carpogonium (right) in seaweeds

Meanwhile, the effectiveness of current biosecurity and legislation on seaweed farming in the Philippines is being determined through a systematic review of the existing legislative policies on seaweed farming (**Table 2**). Farmers from Zamboanga in the Philippines were then interviewed to assess the: (1) current management biosecurity practices and legislative structures for invasive pests and diseases including the key gaps in these structures; and (2) effectiveness of existing farm management and biosecurity practices including policy and/or legislation frameworks or structures in seaweed industry compared with other culture systems. Questionnaires were prepared and used for interviewing farmers from three sites (Layag-layag, Tigtabon Island, and Talabaan). Results showed that the attitude scores of all farmers from the three sites do not significantly differ from each other, while the farmers expressed the view that they do not want the government to take charge of the seaweed farming in the country as the government could cause more problems rather than provide actual solutions.

Table 2. List of existing policies and legislations on seaweed farming in Zamboanga, Philippines

Code	Title	Binding/ Non-binding	Explicit/ Non-explicit
DA-BFAR FAO No.45	Regulations governing the gathering of seaweeds producing agar-agar (1956)	B	E
DA-BFAR FAO No.108	Regulations governing the gathering and farming of seaweeds (1973)	B	E
DA-BFAR FAO No.135	Rules and regulations governing (1981) importation and fishery/aquatic products	B	NE
DA-BFAR FAO No.146	Regulations governing the gathering of seaweeds (1983)	B	E
DA-BFAR FAO No.169 and 169-1	Prohibiting the exportation of fresh Eucheuma seaweeds (1990)	B	E
DA-BFAR FAO No.221	Rules and Regulations governing (2003) importation and fishery/aquatic products	B	NE
Presidential Decree 1433	Plant Quarantine Law of 1978	B	NE
BPI Quarantine Administrative Order 1`	Promulgation PD. No. 1433	B	NE

o Finding effective and safe alternative drugs to manage aquaculture diseases

The study to test the efficacy of different therapeutants against *Caligus* sp. or sea lice in tropical fish under laboratory conditions has been initiated by AQD to investigate the toxic effects of emamectin benzoate in pompano (*Trachinotus blochii*), determine the effective dose in laboratory assay by exposing pre-adult and adult sea lice collected from infested pompano, and evaluate the efficient oral administration of emamectin benzoate in the control of sea lice infestation in pompano. The pompanos are now being reared to juvenile stages to be used for trials.

o Promoting practices or strategies to improve production

AQD demonstrated the production of whiteleg shrimp *Penaeus vannamei* using Biofloc System with sludge removal facility in old earthen brackishwater ponds during wet season as well as verified the economic benefits of using the system. For the soil preparation, biosecurity facilities, e.g. bird-scare, crab fence were installed, and pond facilities, e.g. feeding bridge, feeding boat, discharge pipe, depth gauge, secchi disks and others had been fabricated. Although the ponds are ready for stocking, the shrimp postlarvae (PL) are yet to be delivered, so stocking would commence in early 2019.



Biosecurity fence enclosing the whole production facility (left) and sludge removal facility (SRF) installed in the pond (right)

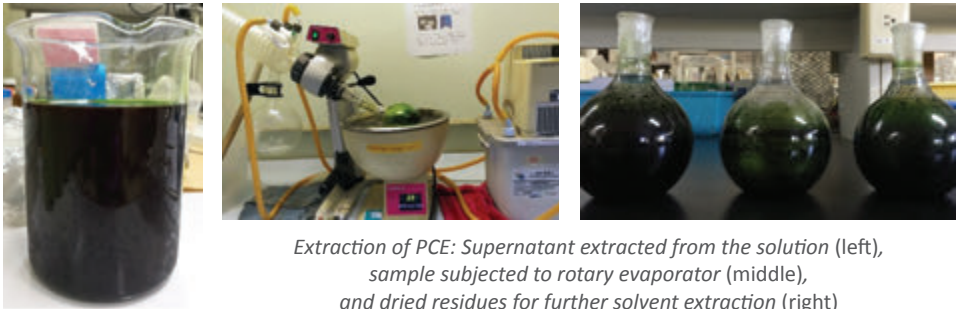
Hatchery production and semi-intensive pond culture of white shrimp *Penaeus indicus* are being improved for sustainable supply. For the hatchery production, broodstocks were sourced from Antique and placed in tanks (10 pairs of male and female). After 30 days of culture, a total of 17,000 PLs were produced. Most larvae were discarded or did not proceed to PL due to lack of diatoms. In the semi-intensive pond culture, growth of shrimp *P. vannamei* using formulated feeds was compared with those using tilapia feeds. Six ponds (700-800 m²/pond) at AQD's Dumangas Brackishwater Station were prepared (cracked dried and applied with lime) with inorganic fertilizers (46-0-0 and 16-20-0), teaseed powder and crustascide. Each pond was stocked at 20 ind/m² where three ponds are meant for testing *P. vannamei* feeds and the other three is for tilapia feeds.

o Finding alternative protein sources in dietary formulations

Protein is the most important component of aquaculture feeds and the general source of protein is fish meal (FM), but this commodity is currently expensive and its availability has been predicted to dwindle in the coming years. With this scenario, researches have been conducted by AQD to decrease the FM inclusion in formulations and finding substitutes using new sources without affecting feed efficiency. One usable by-product is the milkfish offal processed into hydrolysate. Tilapia (*Oreochromis niloticus*) larvae given a diet containing 15% milkfish hydrolysate attained similar growth, survival and feed intake with formulation without milkfish hydrolysate. The protein-enhanced copra meal (PECM) was also evaluated as an ingredient in formulated feed for grouper species, *Epinephelus fuscoguttatus*. Performance parameters of grouper were the same at 0-16% dietary PECM and morphology of liver and digestive tract were not altered at all. In *E. fuscoguttatus*, the amino acid leucine requirement for growth was found to be 2.89% of the diet.



Processing of raw leaves to powdered spinach: fresh spinach leaves (left), freeze-dried spinach (middle), and spinach in powdered form (right)



Extraction of PCE: Supernatant extracted from the solution (left), sample subjected to rotary evaporator (middle), and dried residues for further solvent extraction (right)



Colloidal and concentrated samples in microtube after four hours

For feeds of crustacean species, a green macroalgae *Chaetomorpha linum* is currently being processed for fermentation to increase the levels of nutrients in formulations for the tiger shrimp *Penaeus monodon*. The mangrove crab *Scylla serrata* was also studied for possible synchronization of molting since

this species is highly cannibalistic and, as such, requires formulated diet to be added with Phytoecdysteroids Crude Extract (PCE) from spinach to induce molting. The application of PCE in the dietary inclusion was administered by injection. Although the extraction of PCE from spinach has improved, the method is currently being refined. In the pond culture of *P. indicus*, appropriate feed is also being developed for shrimps produced at the hatchery facilities of the AQD's Tigbauan Main Station and grown into appropriate size for stocking in ponds. Culture in 700 to 800 m² size ponds given two dietary formulations, is ongoing.



Macroalgae being harvested at AQD's Tigbauan Main Station (left), and a close-up of newly harvested algae (right)

o Determining the specific nutrients that enhance growth performance

Quantifying the requirement for amino acids (leucine, isoleucine and histidine) in Asian sea bass juveniles was carried out by AQD in 2018, however, due to the unavailability of sea bass during the testing period, grouper (*E. fuscoguttatus*) juveniles were used instead for initial testing of the six diets. For leucine, the levels used were: 0%, 0.25%, 0.5%, 0.75%, 1.0% and 1.25%, where each test diet has amino acid mixture of aspartic acid (13.5%) and Peruvian fish meal with squid meal (60%). Following the eight-week trial, the leucine requirement for grouper was 2.89%, while the proximate composition analysis, amino acid analysis, and protein retention together with more data analysis are still ongoing.

The potential of thraustochytrid as alternative lipid source for fish oil in hatchery-bred abalone (*Haliotis asinina*) was assessed using abalone juveniles that had been reared to broodstock sizes. The protocol for harvesting cultured thraustochytrid changed from four days to three days, while culture and harvesting of thraustochytrid is ongoing to meet the required amount of extracted thraustochytrid oil.

2.5 Development of responsible and sustainable aquaculture technologies

Maintaining Environmental Integrity through Responsible Aquaculture

The Program aims to address issues on the negative impacts of aquaculture on the environment and how these impacts could be minimized in the development of environment-based aquaculture technology through integration of environmental factors in AQD's research activities, in order to maintain environmental integrity by promoting responsible aquaculture. The projects undertaken include the evaluation of species appropriate for integrated multi-trophic aquaculture (IMTA) where extractive species are able to reduce organic and nutrient loading from aquaculture, and development and promotion of innovations or modifications of culture systems to more environment-friendly ones. In addressing natural stocks depletion of commercially important commodities, studies on species with potentials for resource enhancement are being focused in this Program.

o Developing and promoting efficient and suitable environment-friendly culture systems

A number of ongoing studies have been carried out by AQD for various commodities, e.g. abalone, giant freshwater prawn, marine annelid *Marphysa mossambica*, seaweeds, mangrove crab, shrimp, sea bass, grouper, milkfish, siganid, pompano, snapper, and oyster.

For abalone (*Haliotis asinina*), a partnership between AQD and Ayala Corporation aims to verify a newly developed technology using pipes for grow-out culture in different areas of Panay Island. The first site is in Sicogon where a total of 2,475 abalone juveniles have been stocked in perforated PVC pipes. Growth of the stocks was monitored monthly, and two months later, the abalone attained a mean weight of 9.30 ± 0.21 g and shell length of 3.49 ± 0.02 cm, much better than those obtained in a previous study, using similar pipes as a method of culture but located in a different area. The growth data for the abalone in the Sicogon project site is summarized in **Table 3**. Follow up studies will be carried out in another sites in Aklan in 2019 and Antique in 2020.

Table 3. Mean and range of shell length and body weights of abalone in grow-out culture trials in Sicogon Island, Carles, Iloilo (batch 1)

Date	Shell length (cm)			Body weight (g)		
	Mean	Min	Max	Mean	Min	Max
20 July 2018	2.53	1.87	4.00	3.26	0.90	13.90
9 August 2018	2.87	2.12	3.87	5.01	1.90	12.40
8 September 2018	3.49	2.22	4.88	9.30	2.40	25.50
9 October 2018	3.79	2.16	4.92	11.58	2.70	26.70
8 November 2018	4.13	3.03	5.13	16.82	6.40	32.50

Strategies to improve production of the giant freshwater prawn through stock manipulation and management were continuing at AQD's Binangonan Freshwater Station until the end 2018. Advanced juveniles of *Macrobrachium rosenbergii* were stocked in 2 x 2 x 1.5 m net cages in the Station's floating cage set-up at stocking density of 15 pieces m⁻². Prawns with mean weight of 2.6 g were stocked using the following treatments: all male (AM), all female (AF), and mixed sex (MS). The results at termination of the study after six months of cage culture showed significant difference in the prawns' mean weight with the AM having significantly higher mean weights compared to both AF and MS. No significant difference in survival was noted among treatments. The figure below shows the growth of the prawns in the different treatments while **Table 4** summarizes the production parameters at the end of the six-month culture. AM attained the best production parameters compared to the other two treatments. The MS had the most pronounced heterogeneous individual growth (HIG) as indicated by the highest coefficient of variation in size. All male culture of giant freshwater prawn can then be adopted to improve production.



All male (left), all female (middle) and mixed sex (right) prawns cultured in lake-based cages

Table 4. Production parameters for all male, all female and mixed sex culture of *M. rosenbergii* (Values are means from 4 replicates; different letter superscript indicate statistically significant difference at $P < 0.05$)

Parameter	All Male	All Female	Mixed Sex
Final weight (g)	43.3 ± 4.0 ^a	26.6 ± 3.7 ^b	31.3 ± 2.3 ^b
Size variation (%)	33.1 ± 6.9 ^b	17.5 ± 3.2 ^c	54.1 ± 4.9 ^a 43 ± 12 (male) 20 ± 6 (female)
Survival (%)	57.5 ± 7.5	66.3 ± 9.0	57.2 ± 7.9
DGR (g/d)	0.221 ± 0.022 ^a	0.132 ± 0.020 ^b	0.163 ± 0.013 ^a
SGR	1.49 ± 0.04 ^a	1.22 ± 0.08 ^b	1.53 ± 0.03 ^a
FCR	3.2 ± 0.3 ^b	3.9 ± 0.4 ^a	3.4 ± 0.2 ^{ab}

* Means with different superscripts (a,b,ab,c) are significantly different at $p < 0.05$

Following-up on the successful trial of producing polychaetes (*Marphysa*) using *katsa* (cheese cloth) cages installed in brackishwater ponds in 2017, another experiment was carried out in 2018 using two culture beds (soil surrounded by *katsa* without bottom and soil inside *katsa* cages supported by false bottom). Polychaetes trocophores cultured in ponds for three months in soil inside *katsa* cages supported by false bottom had higher body weight and survival (0.50 ± 0.36 g and 0.9%, respectively) than those reared directly in soil (0.35 ± 0.18 g and 0.4%, respectively). *Marphysa* sp. (3,000 trocophores/m²) cultured in soil inside *katsa* cages for two months supported by false bottom had higher survival (2.8 and 3.8%) at stocking density of 500/m² (Table 5) and growth was better at stocking density of not more than 1500/m². Although the cultured polychaetes were free of shrimp pathogens such as WSSV, AHPND, Yellowhead Virus (YHV), and fish pathogen such as VNN, IHNV was found in both polychaete samples and soil in the experimental site. New raceway ponds were then constructed at a new experimental site where biosecurity systems are being adopted in order to verify the cage culture techniques developed to produce polychaetes.

Table 5. Body weight, total length and survival of polychaete *Marphysa* sp. trocophores stocked at different density levels and cultured for two months in hapa cages installed in brackishwater pond

Stocking density (per m ²)* ³	Run 1 * ¹			Run 2 * ²		
	Body weight (g)	Total length (cm)	Survival (%)	Body weight (g)	Total length (cm)	Survival (%)
500	0.43 ± 0.32 ^c	9.84 ± 3.02 ^c	2.8 ± 1.9 ^a	0.44 ± 0.33 ^a	8.37 ± 3.31 ^b	3.8 ± 1.88 ^a
1,000	0.83 ± 0.39 ^b	14.08 ± 4.14 ^b	1.6 ± 1.2 ^b	0.45 ± 0.24 ^a	7.86 ± 2.48 ^{ab}	1.6 ± 1.41 ^b
1,500	0.98 ± 0.41 ^a	17.26 ± 5.46 ^a	1.1 ± 0.3 ^b	0.46 ± 0.33 ^a	9.66 ± 5.88 ^a	1.8 ± 1.07 ^b
2,000	0.37 ± 0.35 ^c	8.32 ± 4.81 ^c	0.8 ± 0.5 ^c	0.23 ± 0.12 ^b	6.84 ± 2.76 ^c	1.1 ± 0.63 ^c

*¹ Values are mean ± SD (n = 4)

*² Values are mean ± SD (n = 12)

*³ Means with different superscripts (a,b,ab,c) are significantly different at $p < 0.05$

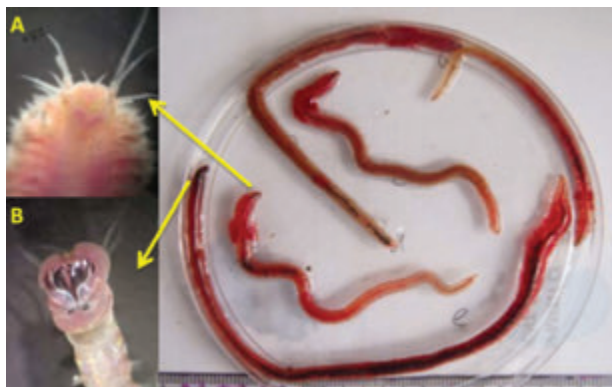
Varying stocking density levels (500, 1,000, 1,500, and 2,000 per m²) were also tested, where the existing stocks of polychaetes were screened for WSSV, TSV, YHV, IHNV, VNN, and Iridovirus prior to restocking in order that the hatchery-bred stocks (old and new) are free from the aforementioned pathogens. The pathogen-free polychaetes were stocked in broodstock tanks with a density of 500 individuals per tank (0.50 m²). The *Marphysa* sp. cocoons were collected from the broodstock tanks and initially stocked in each four-liter capacity basin and grown with biofloc (10 g wet weight) for one month. In run 1, each basin contained 18,916 ± 813 trochophore larvae/tank (37,831 ± 1,625/m²) while in run 2, each basin contained 17,680 ± 1,050 trochophore larvae per tank or at a stocking density of 35,360 ± 2,100 individual/m². After one month, each tank was transferred to separate grow-out tanks (0.50 m²) with sediment depth of five cm. The larvae were fed 10 g of three diets, *i.e.* tilapia diet, milkfish broodstock diet, and high-value diets once a week. After five (run 1) and six (run 2) months, polychaete survival, body weight (blotted dry), and biomass production were determined (see **Table 6**). A continuous water flow-through system was followed throughout the culture period due to heavy rains and roofing was not yet installed in the grow-out set-up. Water salinity was unstable during the culture period, where in most days, salinity ranged from 20-30 ppt while during heavy rainfall, salinity dropped to 5-11 ppt. Sediment temperature was from 27-30 °C.

Table 6. Survival and growth of *Marphysa* sp. fed with different diets in rectangular tanks.

Diets * ²	Run 1 (5 months) * ¹			Run 2 (6 months) * ¹		
	Milkfish broodstock diet	Tilapia diet	High-value diet	Milkfish broodstock diet	Tilapia diet	High-value diet
Body weight (mg)	790 ± 490	320 ± 40	360 ± 20	460 ± 250	220 ± 20	410 ± 120
Biomass (g/m ²)	12 ± 6	22 ± 4	17 ± 8	16 ± 2	17 ± 6	13 ± 5
Survival (%)	0.14 ± 0.10	0.18 ± 0.06	0.13 ± 0.08	0.20 ± 0.09	0.20 ± 0.08	0.10 ± 0.03

*¹ Values are mean ± SE (n = 3)

*² No significant difference among diets at p > 0.05



Polychaete samples harvested after 90 days from a katsa cage installed in brackishwater pond. Unidentified species (A) and Marphysa sp. (B)

Over the years, AQD has developed technologies in broodstock development, seed production and grow-out of economically-important finfishes, crustaceans, mollusks and seaweeds in various stages of development. Several of these technologies had already been successfully field-tested in ponds, pens and cages in fresh, brackish and marine waters in collaboration with fish pond operators, LGUs, NGOs and other international organizations. In an effort to accelerate fish production and export revenues from aquaculture, AQD is committed to intensify techno-transfer of matured aquaculture technologies to stakeholders which will also provide additional and alternative livelihoods to fisherfolks through sustainable aquaculture technologies that are economically viable, environment friendly and socially-equitable.

For the rehabilitation of the shrimp industry, AQD recently launched “*Oplan Balik Sugpo*” that will field-validate or demonstrate sustainable shrimp culture in strategic BFAR demonstration pond sites nationwide. With the collaborative effort of the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) and the private sector, technology information dissemination and extension to end-users nationwide would be accelerated through an initiative known as the Joint Mission for Accelerated Nationwide Technology Transfer Program (JMANTTP II).

2.6 Compilation of scientific data and information to support policy on sustainable aquaculture

Adapting to Climate Change

The Program is aimed at identifying the changes in the environment brought about by the changing climate that affect the aquaculture sector, preparing the sector to the possible effects of these changes, minimizing and mitigating the adverse impacts of climate, and ensuring the continued operation of all aquaculture production systems under the changing climatic conditions.

- o Generating scientific information on the effects of high water temperature on the reproductive performance and recruitment of economically important marine aquaculture fishes*

Reproduction, spawning and recruitment are among the physiological processes that are highly affected by environmental temperature. In marine fish, gonadal development, spawning, embryonic development, hatching and larval survival have been severely affected at 33°C, while larval development and survival in mangrove crab are also affected at the same temperature. Abalone can experience poor gonadal development, spawning, embryonic development, and hatching, while survival of broodstock and larvae at 31°C and 33°C. Growth and survival of rotifers and caepods are likewise affected by varying temperature, salinity and acidity caused by sudden change in weather conditions. Seaweeds also experience poor growth during prolonged periods of high water temperature, and higher incidence of diseases and epiphytic infestation.

The fish farmers and the general public should have better understanding about climate change and its likely impact to their livelihood opportunities for better preparation and adaptation. Since largely almost nothing is known how climate change will affect the biology of various species presently farmed and the various support systems, important data on this aspect would be generated by AQD to serve as basis for the development of mitigation

measures. Improvements and innovations on the different aquaculture holding systems and structures would also be necessary to lessen and/or reduce the impact on fish supply production.

2.7 Generation of appropriate technologies for rural aquaculture to provide livelihood and alleviate poverty

Meeting Social and Economic Challenges in Aquaculture

In 2018, five (5) research projects were implemented by AQD under the Program with main-stream activities focusing on the social and economic aspects of aquaculture and resource enhancement to contribute to the development of aquaculture-based livelihoods in coastal and inland fishing communities in Southeast Asia. The studies were intended to allow the fishing households to acquire knowledge and develop aquaculture skills that would enable them to adopt sustainable farming of economically important aquatic animals and plants, as well as to demonstrate to them that hatchery-produced juveniles are instrumental in rebuilding overfished fishing habitat through community-based strategies.

- o Prioritizing collaborative R&D in aquaculture in the region for a clear regional assessment and understanding of the role of aquaculture in poverty alleviation*

The increasing demand of eel seeds for aquaculture in recent years has prompted SEAFDEC to conduct a survey of the Anguillid eel industry focusing on the glass eels in the Southeast Asian region through the regional study “Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia” led by the SEAFDEC Secretariat and funded by the Japan ASEAN Integration Fund (JAIF). Under this regional study, AQD has been tasked to conduct a survey of the Anguillid eel aquaculture industry with focus on glass eel nursery in the Philippines. Together with a survey of eel nursery farms in the Philippines and Viet Nam, and the observed practices in farms in Japan, the survey could provide basis for studies on nursery refinements to improve the current glass eel production. The eel farms surveyed in the Philippines were in the Provinces of Cagayan, Zambales, Laguna, Pampanga, Tarlac, Agusan del Norte, Saranggani, Cavite; and in Davao and General Santos City. In Viet Nam, the farms were located in Khanh Hoa and Phu Yen in south central coast of Viet Nam. In the Philippines, glass eels are sourced from Aparri in Cagayan Province, and in Mindanao such as in General Santos City, Saranggani and Davao. In Viet Nam, glass eels are from the Provinces of Quảng Ngãi (2-5%), Bình Định (10-15%), Phú Yên (>80%), Khánh Hòa (<1%), and Ninh Thuận (<1%). For both countries, post-transport survival is generally high at 95 to almost 100%. The price of glass eels in the Philippines ranges from PHP 3,500 to 5,000 per kg, but pre-sorted glass eel with at least 90% *A. bicolor pacifica* are sold at PHP 20,000 per kg. In Viet Nam where more than 90% of Anguillid eels are claimed to be *A. marmorata*, the equivalent price range of glass eels is about PHP 23,000 to 34,000 per kg. In terms of good aquaculture practices, quarantine upon arrival (mostly through salt bath and rarely with antibiotics) are practiced in the Philippines but those in Viet Nam are stocked directly in rearing tanks. Initial report indicated that most farms use indoor nursery facilities and outdoor ponds with static-renewal system of water exchange, recirculating system, or flow-through system with water sourced from deep well. The study is expected to come up with: (1) updated assessment of the Anguillid eel nursery industry; (2) value chain analysis of the eel nursery industry; (3) market development strategies for existing eel species; (4) problems in Anguillid eel nursery

identified; and (5) best management practices for Anguillid eel nursery culture determined and published for dissemination to the AMSs involved in Anguillid eel culture.



Eel farmers report almost 100% survival after transport from source to nursery



Glass eels are mostly reared in indoor cement tanks with aeration and good water exchange

In another socioeconomics study, the farming of seaweed (*Kappaphycus alvarezii*) remains as a significant source of income for migrants and those displaced by war especially in Zamboanga City and Tawi-tawi. A global seaweeds project was conducted in AQD starting 2018 parallel with the other project counterparts in Indonesia and Tanzania. For the component in the Philippines, data collection was conducted through interview and focus group discussions with farmers, traders, processors, and local government officials in top seaweed-producing provinces in the Philippines such as Zamboanga, Tawi-Tawi, and Bohol. Results of the survey showed that seaweed farming households often have many members since dwellings were shared by extended families. All members of the family are also involved in the farming as children and other household members help in the preparation of the seedlings offshore while husbands and wives are often in-charge of the actual farming. Despite having equal interest in seaweed farming, men have relatively more access to support from government and non-government organizations compared to women. The results also showed that across three different provinces, the average monthly income were not significantly different but seaweed prices in Zamboanga were lower since seaweeds were often sold fresh. Farmers often sold their seaweeds to village traders unless the farm is near the town center. Methods for seaweed farming are mostly learned from family members and other village residents. The survey also showed that farmers will only adopt a particular seaweed planting methods when it shows higher yield and lesser cleaning effort. Incidence of diseases, epiphytes and bad weather condition were the most cited reasons for crop failure, so that when crops are affected by these conditions, farmers opt to obtain assistance from family members, traders and microfinance organizations. Price fluctuations of seaweeds had largely influenced the farmer's decision to either continue or stop the farming. Results also showed that only few farmers, mostly from Bohol and Zamboanga, have licenses to operate seaweed farms. Under the study, analysis of the seaweeds value chain would be carried out for the benefit of smallholder seaweed farmers, national policy-influencing plan would be developed, and product insurance would be explored to reduce the risks in seaweed farming.



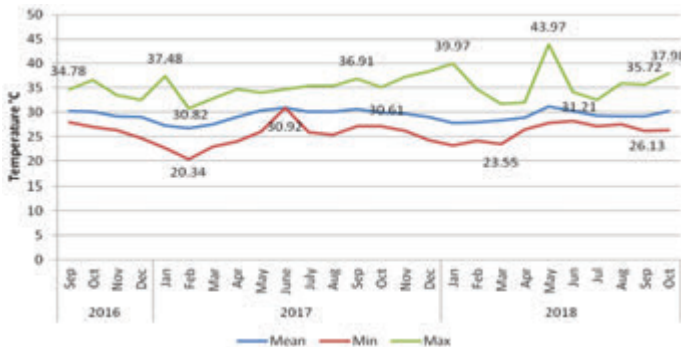
In study sites in the Philippines, women are often engaged in the preparation of planting materials



Sun-drying of seaweed is a common sight in the study sites in the Philippines

o Addressing emerging issues on the impacts of climate change and global trade

Seaweed is one of the major export commodities of the Philippines and its farming is often the livelihood of low-income households in many coastal communities around the country. However, seaweeds production in the Philippines showed a declining trend while global demand for seaweeds and its products is projected to increase annually. Studies have shown that coastal marine ecosystems along with the goods and services they provide are threatened by anthropogenic global climate change. To contribute to better understanding of these climate-related concerns, some of the key activities in 2018 include monitoring the seaweed farming operations of fisherfolks in Panobolon in Nueva Valencia in Guimaras Province while test planting of seaweeds obtained from AQD had been carried out to compare the performance with the seaweed farming livelihood in the study area. Results showed that the test planted seaweeds grew but were heavily infested with epiphytes, herbivorous fish and shells. The seaweeds were cleaned and replanted, but grew in clumped form rather than showing long-branches. Majority of seaweed growers in shallow areas stopped cultivating in 2018 primarily due to unpredictable weather patterns and lack of seedling propagules. In shallow areas, farmers reported more problems such as profuse bloom of algae and the presence of mud, slimy worms, and black egg-like slime attached to the thalli. Eventually the seaweeds melted due to *ice-ice* despite regular cleaning. The farmers who planted in deep areas continued farming, although confronted with the same challenges experienced by growers in shallow areas. Transition of season affected the seaweeds growth performance, where extreme temperature and salinity resulted in depigmented seedlings and mortality. Despite the constraints encountered, a few growers continue farming until the early quarter of 2018. Overall, the seaweed growers showed a declining interest from 2016 to 2018 due to lack of good-quality seedlings and low market price of fresh harvest.



Daily sea surface temperature reading in a shallow (depth 1.5 m-1.8 m) seaweed farming area

o Sustaining multi-agency collaboration and sharing of information

AQD and the Japan International Research Center for Agricultural Sciences (JIRCAS) collaborated for *the Demonstration and Verification of Sustainable and Efficient Aquaculture Techniques by Combination of Multiple Organisms from 2016-2020*, aimed at establishing practically feasible and economically profitable modified IMTA systems that suit local fish farming environment. For the socioeconomics component, milkfish grow-out trials aimed to explore and demonstrate improvement of IMTA systems were carried out with the cooperation of organized fisherfolks and the local government officers in Barangay Pandaraonan, Nueva Valencia, Guimaras Province. As in previous years, the science-based milkfish culture technology developed by AQD was incorporated with the indigenous knowledge of fisherfolks to carry out the activities in 2018 that include the sixth culture run for demonstrating milkfish, *Chanos chanos* grow-out with sandfish, *Holothuria scabra*. Although the milkfish harvest attained local marketable size (>250 g), there was variability in the size distribution of the harvest. Value-adding was adopted by deboning, cooking of under-sized milkfish in oil and the indigenous process of partial sun-drying of split-gutted milkfish washed in brine solution, the latter of which was preferred by local women because of the lower cost involved. However, the techniques for integrating of sandfish and seaweeds in IMTA of milkfish for mitigating environmental problems and increasing economic benefits still need further improvement. In 2019, a modified mariculture pen set-up will be stocked with more sandfish during the fallow period to verify the improved survival and growth observed in 2018. The accumulation of aquaculture skills through the participation of fisherfolks in these IMTA trials will also be evaluated in the context of the sustainable livelihoods analysis.



Fisherfolk collaborators observe sampling of milkfish harvest in Pandaraonan, Nueva Valencia in Guimaras Province, Philippines in 2018

o Other aquaculture R&D activities

AQD organized two regional meetings this year on important aquaculture topics such as fish health and nutrition. On 17 May 2018, a regional seminar-workshop on Establishment of the Regional Database of Alternative Feed Ingredient in Southeast Asia (AFID) was held in Bangkok, Thailand with focal persons from the Member Countries and observers from other SEAFDEC Departments and partner agencies, e.g. Network of Aquaculture Centres in Asia-Pacific (NACA). The project was funded by JTF.



Representatives from Member Countries accessing the Database during the workshop

The Focal Persons had hands-on experience of the database by giving them access to the site. AQD gave a run-through of functions including introduction of the parts (e.g. dashboard, log-in page), contents (e.g. ingredient types, species group), and user accounts or page roles (e.g. administrator, encoder). The navigation of the database as administrator starting from logging into the user account, to familiarization of the dashboard, adding feed ingredient entry and categorizing the feed ingredient into types were also explained. Concerns on privacy, database maintenance, accessibilities and limitations of the Database were also tackled and solved during the discussions. Suggestions and information that were received during the Meeting from focal persons were noted and applied on the Database.



An article about the launching of AFID

On 13 July 2018, the Regional Database of Alternative Feed Ingredients in Aquaculture was officially launched by its proponents under the web address <http://afid.seafdec.org.ph/>.

The “ASEAN Regional Technical Consultation on Aquatic Emergency Preparedness and Response Systems for Effective Management of Transboundary Disease Outbreaks in Southeast Asia (ASEAN RTC on AEPRS)” was held on 20-22 August 2018 in Bangkok, Thailand. A total of 71 participants including country representatives from ASEAN-SEAFDEC Member Countries, resource persons, JAIF representatives, private sectors of selected countries, Thailand aquaculture farmers, and representatives from DOF Thailand, and staff from SEAFDEC Departments attended the Consultation.



Participants present during the ASEAN RTC on AEPRS in Bangkok, Thailand

During the Consultation, country representatives presented the current status of aquatic emergency preparedness and response systems concomitant to their respective national laws, legislations, SOPs and aquatic animal health strategies, among others. The Resource Persons also presented the importance of aquatic emergency preparedness and response systems for effective management of transboundary disease outbreaks based on primary accounts documented at the global or regional level. After the presentations, a Workshop ensued resulting in the identification of gaps and the priority areas for R&D collaboration that led to the development of the Consultation's policy recommendations. Then the Regional Technical Guidelines for Early Warning System for Aquatic Animal Health Emergencies was drafted and is currently being reviewed by the countries. The Consultation was funded by Japan-ASEAN Integration Fund (JAIF) and was held as a collaborative effort of AQD, DOF Thailand and NACA.

o Technology Verification and Extension

In 2018, AQD changed the name of its Technology Verification and Demonstration Division to Technology Verification and Extension Division (TVED) to be primarily tasked with conducting verification work on sustainable technologies that are developed or refined through research, and translating these into adoption-ready production systems. Pilot scale production will be done by TVED using recent techniques to compare with existing methods and to determine if these recent findings improve production and profitability. TVED is also responsible for technology promotion and technical services.

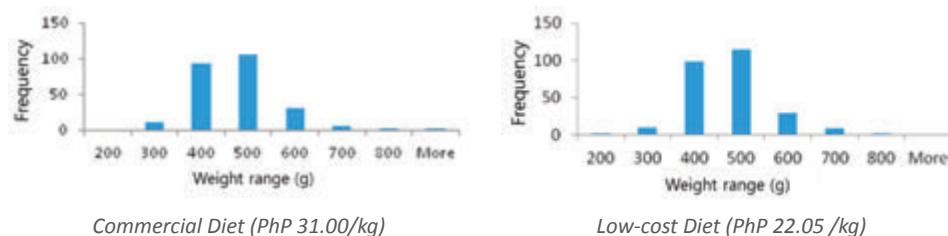
As part of AQD's mandate to disseminate technologies through lead fishery agencies of Member Countries, TVED is closely working with BFAR on the establishment of multi-species hatcheries in different parts of the Philippines. In addition, AQD also collaborates with BFAR on JMANTTP which involves on-site training and demonstration activities in various BFAR regional centers in the country.

Meanwhile, formulating and producing low-cost, quality feeds and fish diets for the fish farmers is also one of AQD's thrusts. Low-cost feeds for milkfish had been formulated, with the ingredients composition presented in **Table 7**. These low-cost feeds are now being used in various demonstration farms of BFAR.

Table 7. Ingredients composition of “low-cost feeds for milkfish”

Ingredient	g/100 g of dry diet	Ingredient	g/100 g of dry diet
Danish FM	0.25	Wheat pollard	5.00
Sardines FM	2.50	BF	12.00
Poultry by-product	10.00	SBO	0.50
Defatted soybean	23.00	DFO	0.50
DDGS	4.00	Vit. Mix	0.03
Copra meal	10.00	Vitamin C	0.05
Acetes	0.25	Rice bran	31.92

Compared to the commercial feeds (PHP 31.00/kg) and poultry by-product (PHP 45.00/kg), the price of the low-cost feed (PHP 22.05/kg) is lower. Preliminary results of the test feeds shown in the figure below appear promising, while another low-cost diet formulation had also been initiated.



Preliminary results of the low-cost feed formulation for milkfish cultured in floating net cages at AQD's Igang Marine Station

Different aquatic commodities are produced as by-product from the different research and technology, verification and demonstration activities of AQD. Milkfish fry continued to be on top with hatchery production (**Table 8**) having a total value of PHP 1,054,505.00. Tilapia hit a total sale of PHP 455,854.00 for both fry and fingerlings with buyers coming from Iloilo, Aklan, Antique and Negros Occidental. Mangrove crab reached a production income of PHP 1,121,736.00 from buyers coming from Iloilo, Capiz, Aklan, Negros, Masbate, Pangasinan, Pagadian and Zamboanga. Since production of shrimp is still continuing, the equivalent production value could not yet be confirmed. For grow-out, milkfish is also the top commodity with a total production of 2,577 kg but pompano, being a high-value commodity, yielded the highest production value at PHP 447,974.00 (**Table 9**).

Table 8. Hatchery output of AQD

Commodity	Quantity (pcs)
Milkfish	3,495,350 fry
Shrimp	614,000 fry
Tilapia	1,328,769 fry 12,910 fingerlings
Mangrove crab	278,420 crab instars



Milkfish harvest at AQD's Igang Marine Station

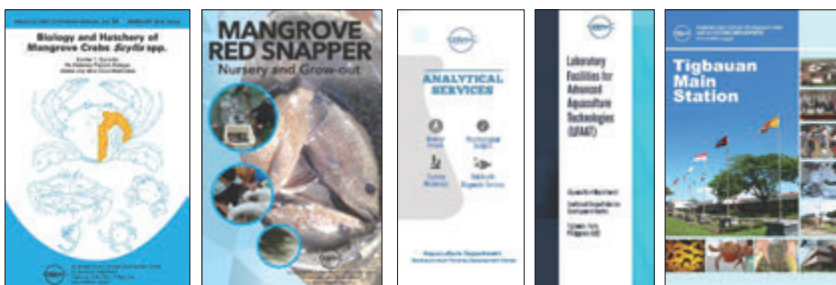
Table 9. Grow-out production of various commodities at AQD (IMS and DBS)

Commodity	Volume (kgs)	Value (PHP)
Milkfish	2577.00	320,966.00
Pompano	1808.60	447,974.00
Siganid	422.75	77,702.50
Snapper	58.00	11,905.00
Tilapia	46.00	5,080.00
Seabass	18.80	5,625.00

o Training and Information

For the purpose of enhancing the knowledge of a critical mass of experts by sharing updated information on aquaculture advances to the region, AQD continued and improved its training and information dissemination activities. In 2018, AQD trained a total of 300 participants in 33 training courses while its internship program was availed by 25 individuals who were assigned in different research areas in AQD for skills enhancement, specifically improving their proficiency and gaining experience in their chosen aquaculture field. On-the-job training (OJT) program was availed by 414 students from 45 schools and universities all over the country, providing students with hands-on participation in AQD activities to satisfy their academic requirements and to give them practical knowledge and skills.

Also in 2018, the aquaculture extension manual on “*Biology and Hatchery of Mangrove Crab*” was revised with its third edition that includes techniques to improve the viability of the mangrove crab hatchery technology. Brochures and flyers on mangrove red snapper, manual sexing of milkfish, analytical services, laboratory facilities for advanced aquaculture technologies, and updated Tigbauan Main Station flyers were also produced.



Publications produced by AQD in 2018

For visibility, AQD attended and organized four exhibitions including the AQD Aquaculture Week in SM City Iloilo, Regional Science and Technology Week in Robinsons Place Roxas, 2nd National Bangus Congress, and 2nd Agri-Aqua Investment Forum both at Iloilo Convention Center. Overall, the exhibits gathered over 20,000 visitors.

AQD's official website (www.seafdec.org.ph) has been updated and improved receiving a total of 63,159 unique visitors in 2018. As for its official Facebook page (www.facebook.com/seafdec.aqd), posts uploaded for this year acquired 3,817 likes and views, and followers increased from 2,992 to 3,870. 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 2018, the repository received a total of 118,571 accesses.

3. Strategy III: Enhancing trade and compliance of the region's fish and fishery products with market requirements

3.1 Regular monitoring of chemical and biological contaminants to ensure seafood safety

Monitoring of Biotoxins and Harmful Algal Blooms

Globally, marine biotoxins pose a major and growing threat to human health resulting in human poisoning or even death following the consumption of contaminated shellfish or fish, as well as in fish and shellfish mass kills, and death of marine animals and birds. Biotoxins, as defined by the Codex Alimentarius Code of Practice for Fish and Fishery Products (CAC/RCP 52-2003), 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. Monitoring seafood for toxicity is necessary to mitigate these risks but such monitoring can be complex due to the variation in toxin contents between individual shellfish, different detection and even extraction methods for the various toxins requiring a decision which toxins should be tested for, and the frequency of sampling to ensure that toxicity does not rise to dangerous levels in temporal or spatial gap between sampling times or locations.

The MFRD Programme through the Post-Harvest Technology Centre of Agri-Food and Veterinary Authority of Singapore, therefore implemented the project "**Chemical and Drug Residues in Fish and Fish Products in Southeast Asia – Biotoxins Monitoring and Harmful Algal Blooms 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 the consumption of contaminated shellfish and fish. The first phase of the project (2009 to 2012) 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-SEAFDEC Member Countries. The second phase of the project from 2013 to 2017 addressed the needs of Member Countries and continued with capability building in biotoxins analyses and monitoring, focusing on other biotoxins like the Amnesic Shellfish Poisoning (ASP) toxin (Domoic Acid) and Azaspiracid (AZA) toxin. Brevetoxins (BTX) which causes Neurotoxic Shellfish Poisoning (NSP) was also included in the new project phase

as ASP, AZA and BTX, along with DSP and PSP, should be regulated according to CODEX for shellfish. From 2015, MFRD Programme also incorporated new activities under this project to enhance regional capabilities for the identification of toxic HAB species strengthening the Member Countries' capability for biotoxins monitoring. The project was extended for two more years (2018-2019) upon request from the Member Countries during the Regional Training Course on Identification of HAB Species in the ASEAN Region in 2016 for MFRD Programme to organize additional training courses to enhance the region's capabilities in managing toxic HAB incidences and to give the participating countries more time to complete the biotoxin monitoring surveys.

As a continuation of the "RTC on Specimen Preservation and its Application in HAB Monitoring and Studies" conducted in 2017, MFRD Programme organized the "Regional Training Course on Culturing for Harmful Algal Bloom (HAB) Species and Toxin Characterization" in collaboration with the Institute of Ocean & Earth Science (IOES), University of Malaya (UM), Bachok Marine Research Station (BMRS) from 8 to 14 July 2018 in Kelantan, Malaysia. Comprising lectures and hands-on practical sessions, the 5-day training course was tailored to focus on culturing cells of HAB species for identification and enumeration using microscopy and molecular methods. With three (3) expert trainers from IOES-UM and 1 Japanese expert as resource persons, the training had exposed the 20 trainees from 10 AMSs to biotoxin characterization, particularly on the use of biotoxins' detecting tools. After the training, the participants commended the MFRD Programme for imparting the knowledge and skills that enabled them to better appreciate the different HAB species responsible for marine biotoxins.



The RTC on Culturing HAB Species and Toxin Characterization

4. Strategy IV: Addressing international fisheries related issues from a regional perspective

4.1 Development of regional standards, policies and guidelines to enhance intra-regional and international trade

Guidelines on Cold Chain Management for Seafood

Fish and seafood are important sources of protein for the ASEAN region, and traded in high volumes not only within the region but also exported across continents, especially to the European and North American markets. Fish and seafood are highly perishable commodities and sensitive to temperature changes, with quality that changes starting almost immediately following catch or harvest, and compromises the safety and quality of the seafood produced. Cold chain management is therefore essential in minimizing deterioration, which can occur through microbiological metabolism, oxidative reactions, and enzymatic activity, and accelerated through poor temperature control. Throughout the supply chain, the fisheries industry heavily relies on proper cold chain management practices, such as the application of ice, use of refrigerated seawater, storage in refrigerated facilities, and chilling or freezing, to ensure the quality, safety and commercial viability of its products. However, these low temperature conditions must also be supported by good and hygienic handling practices, to effectively delay spoilage of the fish and seafood. In the tropical climates of the ASEAN region, temperature management is challenging and poor management could lead to breakage in the cold chain and speed up the rate of quality deterioration in this high-value commodity resulting in low value seafood.

Fisheries industry players in the ASEAN face many challenges in the implementation of a cold chain management system, such as limited access to technologies and appropriate facilities, and lack knowledge of cold chain management practices. However, with the advances in technology, these cold chain technologies have now become more accessible to the players in the seafood industry. Thus, maintaining a cold chain throughout the supply chain of seafood is now more feasible than it has ever been before. In an effort to address such challenges, MFRD Programme implemented the project **“Cold Chain Management for Seafood”** starting in May 2015 with support from the Government of Singapore, with the objectives of: 1) Assisting in upgrading the regional seafood industry in cold chain management and technologies; and 2) Developing generic guidelines on cold chain management for the seafood industry in the region. Since 2015, the MFRD Programme has conducted several seminars and workshops for the government and industry participants from the ten AMSs, where experts from Curtin University and the Sydney Fish Market were invited to provide capacity building and advice on cold chain technologies and practices, and monitoring control in seafood quality assurance.

On 18-19 April 2018, the MFRD Programme organized the “End-of-Project Meeting on Cold Chain Management for Seafood” in Singapore, which was attended by representatives from the respective governments and industry practitioners of the AMSs. Feedback from the national consultations on the draft guidelines on cold chain management which takes reference from international standards and in the context of ASEAN seafood industry, completed by the AMSs participants in 2017, was collated and discussed at this Meeting. At the end of the Meeting, the “Regional Guidelines on Cold Chain Management of Fish and

Fishery Products in ASEAN Region” was finalized and endorsed for submission for approval by the SEAFDEC Council and subsequently to the ASEAN mechanism.



End of project meeting participants (top) and visit to Singapore’s fishery port and fish processing plant (above)

4.2 Development and promotion of traceability system for fish and fishery products in the region

Traceability system is one of the important emerging market requirements due to the pressing needs expressed by the markets to ensure that fish and fishery products are not derived from IUU fishing, and helps facilitate tracking the flow of products through the production processes or supply chain. Under the project **“Combating IUU Fishing in the Southeast Asian Region through Application of Catch Certification for Trading of Fish and Fishery Products”** implemented by MFRDMD since 2013, the efforts made in 2018 focused in following-up with the ASEAN Member States their respective actions to implement the **“ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain”** which was endorsed by the 37th Meeting of the ASEAN Ministers on Agriculture and Forestry (AMAF) in 2015, and supporting the introduction and implementation of the “ASEAN Catch Documentation Scheme” in pilot countries of the Southeast Asian region. In order to monitor the implementation of the said ASEAN Guidelines, MFRDMD conducted a series of “Consultative Meetings for Promotion of the ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain” in the AMSS, *i.e.* in Putrajaya, Malaysia (16-19 July 2018); in Jakarta, Indonesia (23-26 July 2018); in Manila, Philippines (6-9 August 2018); in Phnom Penh, Cambodia (13-16 August 2018); in Nay Pyi Taw, Myanmar (1-4 October 2018); in Vientiane, Lao PDR (15-18 October 2018); in Hanoi, Viet Nam (29 October - 1 November

2018); and in Bangkok, Thailand (12-15 November 2018). Through the Consultative Meetings, the adoption of the ASEAN Guidelines was promoted while the current status made by the AMSs in the implementation of the Guidelines was assessed through the conduct a self-evaluation on the status in the implementation of the ASEAN Guidelines in their respective countries. Results of the self-evaluation indicated the percentage accomplishment of the countries, *i.e.* 92.4% for Malaysia, 96.4% for Indonesia, 96.4% for the Philippines, 84.8% for Cambodia, 94% for Myanmar, 60% for Lao PDR, 92.4% for Viet Nam, and 98% for Thailand. Although the results might not be conclusive as these did not imply that countries with higher scores have fully implemented the Guidelines, these information helped indicate the areas where particular countries need further assistance in the implementation of the Guidelines. The results from the self-evaluation was presented to the SEAFDEC Program Committee during its 41st Meeting in 2018, and an interim report of the feedback and self-evaluation of the implementation of the ASEAN Guidelines compiled through country visits, would be finalized for publication during the 1st quarter of 2019.



(From top-bottom; left-right) Consultative visit to Cambodia, Indonesia, Myanmar, and Philippines to assess the current status made by the countries in the implementation of the ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain

Also under the same Project, the development of the **“ASEAN Catch Documentation Scheme”** or ACDS was initiated by MFRDMD in collaboration with TD. In 2017, the electronic system of the ACDS (eACDS) was pilot-tested in Brunei Darussalam in 2017. Since then, series of consultations and on-site training sessions on the use of eACDS for relevant stakeholders were conducted in Brunei Darussalam through its Department of Fisheries, and the eACDS system was on its testing process afterwards. On 2-5 April 2018, the “Third On-site Training and Kick-off Pilot Testing for eACDS” was organized in Brunei Darussalam to discuss with relevant national stakeholders and government officials, and identify problems including issues, on the application design. Initial results of the evaluation of the

eACDS implementation in Brunei Darussalam and the issues identified were presented at the 41st Meeting of SEAFDEC Program Committee in 2018.

In addition to Brunei Darussalam, the other AMSs also expressed their interest in exploring the possibility of applying the system in their respective countries, e.g. Viet Nam, Myanmar, and Malaysia. Thus, introduction of the eACDS system was first conducted for relevant stakeholders and Directorate of Fisheries (D-Fish) of Viet Nam in December 2017, and subsequently, further discussion was made on 12-13 September 2018, particularly regarding the preparation of Key Data Elements for eACDS database development, and selection of pilot site in the country. For Myanmar, introduction of the eACDS system was conducted for stakeholders and the Department of Fisheries of Myanmar during the “Consultation Visit to Myanmar for Introduction of the eACDS to Relevant Stakeholders and Observing the Port Control and Fishing Licensing System” on 11-14 June 2018. During the Consultation Visit, introduction and demonstrations of overall eACDS system including issuance of catch declaration, movement documentation, catch certification, processing statement, and re-export certification were made. Discussion on the preparation of Key Data Elements for eACDS database development and selection of pilot site in Myanmar was convened on 25-28 September 2018. In Malaysia, the introductory workshop on the eACDS was conducted in 2018, in response to the request of Malaysia to be included as one of the pilot sites for the eACDS, during the 41st Meeting of SEAFDEC Program Committee in 2018.



Third On-site Training and Kick-off Pilot Testing for eACDS in Brunei Darussalam



Visit for introduction of the eACDS in Viet Nam



During the Consultation Meeting on Introduction of the eACDS and Consultation Visit on Port State Measures



Discussion on preparation of Key Data Element for eACDS database development and selection of pilot site in Myanmar

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

5.1 Promotion of small-scale fisheries and gender integration

After the endorsement of the “FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines)” at the 31st Session of the FAO Committee on Fisheries (COFI) in June 2014, SEAFDEC and the Member Countries have been giving increased attention to the SSF Guidelines as important reference for the promotion of sustainable small-scale fisheries in the Southeast Asian region. Through the project **“Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia”** supported by the Government of Sweden (see 7.1), SEAFDEC organized the “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” on 26-28 September 2017 in Bangkok, Thailand with a view to clarifying the relevance of taking “human rights-based approach” and ensuring “gender-equitable small-scale fisheries” in support of sustainable small-scale fisheries in ASEAN-SEAFDEC Member Countries. The Experts Workshop came up with the draft “Policy Brief: Applying Human Rights-based and Gender Equality Approaches to Small-Scale Fisheries in Southeast Asia” which was supported by the SEAFDEC Council during its 50th Meeting in 2018 further promotion and dissemination in the region. In line with the “SSF Guidelines” and the “Policy Brief” that address the need for integration of gender perspectives in fisheries, SEAFDEC Secretariat also proposed to develop the “SEAFDEC Gender Strategy” to provide a framework for facilitating the efforts of SEAFDEC in integrating gender in its future programs and projects. Getting the support of the SEAFDEC Council, the SEAFDEC Gender Strategy was developed through consultation among the SEAFDEC Secretariat and Departments during the “Inter-Departmental Workshop for Development of SEAFDEC Gender Strategy” organized on 3-4 September 2018 in Bangkok, Thailand. The Strategy was submitted to the SEAFDEC Program Committee for consideration, and was subsequently endorsed for approval during the forthcoming SEAFDEC Council Meeting in 2019.

In a parallel initiative and in support of the integration of gender in fisheries, the “Toolkit for Gender Assessment in Small-scale Fisheries” is being developed through a series consultations, starting from the “Experts Consultation Workshop on Guidance for Monitoring and Evaluation of Gender Equity and Social Well-being in Fisheries Communities” held on 8-10 August in Bangkok, Thailand in collaboration with partners, *i.e.* the Asian Institute of Technology (AIT), Asian Coastal Resources Institute-Foundation Cambodia (CORIN-Asia Cambodia), Food and Agriculture Organization of the United Nations (FAO), Learning Institute (LI), Mekong River Commission (MRC), Sustainable Development Foundation (SDF), Sweden Embassy in Bangkok, Thailand, and The Oceans and Fisheries Partnership (USAID Oceans). Once finalized, this Toolkit would be one of the most important guides for the SEAFDEC Departments to support the implementation of the SEAFDEC Gender Strategy, as well as for countries in Southeast Asia to conduct gender assessment with a view to mainstreaming gender perspectives into the development of small-scale fisheries and aquaculture in region.

5.2 Monitoring and enhancing awareness on international fisheries-related issues

Issues related to trade of fish and fishery products have been immensely discussed at the international and regional levels during the past decades to secure the sustainable use of resources and promote people's welfare and equitable benefit to stakeholders involved in fishery-related activities. As a result, a number of global policy frameworks and instruments including market-driven measures had been agreed upon and applied by relevant organizations and/or importing countries. The project **"Assistance for Capacity Building in the Region to Address International Fish Trade-related Issues"** is being implemented by the SEAFDEC Secretariat to help in monitoring the emerging international fish trade-related issues and requirements, and subsequently enhance the understanding and capacity of the ASEAN-SEAFDEC Member Countries in addressing such issues. Furthermore, the project also aims to facilitate the development of common views among the countries, and to make sure that such views and the Southeast Asian region's specificity, especially with respect to the fisheries sector, is reflected during the discussions at appropriate regional and international fora. In 2018, SEAFDEC participated and provided technical inputs in international events that discuss international fisheries-related issues that might have implications in the development of fisheries of the region, namely:

- FAO Panel "Fighting IUU Fishing and Seafood Fraud: Enhancing Traceability and Transparency through Strengthened Governance Frameworks (Organized by FAO on 11 March 2018 in Boston, USA)
- 14th Meeting of the ASEAN Working Group on the CITES (organized by ASEAN on 20-22 March 2018 in Luang Prabang, Lao PDR)
- Regional Technical Seminar on Joining Forces in the Fisheries Sector: Promoting safety, decent work and the fight against IUU fishing (organized by FAO, Apostleship of the Sea, ILO and IMO on 21-22 March 2018 in Manila, Philippines)
- Consultative Forum on Regional Cooperation Against Human Trafficking, Labour Exploitation, and Slavery at Sea (organized by ILO on 27-28 March 2018 in Bali, Indonesia)
- CITES International Technical Workshop on Eels (*Anguilla* spp.) (organized by CITES on 18-20 April 2018 in London, UK)
- 7th APFIC Regional Consultative Forum Meeting: Sustainable Development for Resilient Blue Growth of Fisheries and Aquaculture (organized by APFIC on 7-9 May 2018 in Cebu, Philippines)
- 35th Session of Asia-Pacific Fishery Commission (organized by APFIC on 11-13 May 2018 in Cebu, Philippines)
- 22nd Session of Indian Ocean Tuna Commission (organized by IOTC on 21-24 May 2018 in Bangkok, Thailand)
- 15th World Tuna Trade Conference and Exhibition (organized by INFOFISH on 28-30 May 2018 in Bangkok, Thailand)
- 5th Meeting of the Parties to the Southern Indian Ocean Fisheries Agreement (organized by SIOFA on 25-29 June 2018 in Phuket, Thailand)
- PSMA Part 6 Working Group on Requirements of Developing States (organized by FAO on 5-6 July 2018 (in Rome, Italy)
- 7th Meeting of Regional Fishery Body Secretariats Network - (RSN-7) (organized by FAO on 7 and 13 July 2018 in Rome, Italy)
- 33rd Session of the Committee on Fisheries (COFI) (organized by FAO on 9-13 July 2018 in Rome, Italy)

- Animal Committee Meeting of CITES (organized by CITES on 16-21 July 2018 in Geneva, Switzerland)
- Global Conference on Tenure and UserRights 2018: Achieving Sustainable Development Goals by 2030 (UserRights 2018) (organized by FAO on 10-14 September 2018 in Yeosu, Republic of Korea)
- 9th GEF International Waters Conference “Sustaining International Waters Cooperation” (organized by GEF on 5-8 November 2018 in Morocco)
- 11th RPOA-IUU Coordination Committee Meeting (organized by RPOA-IUU on 12-15 November 2018 in Yogyakarta, Indonesia)
- 14th Senior Officials’ Meeting (SOM-14) and 7th Ministerial Meetings of CTI-CFF (organized by CTI-CFF on 12-16 November 2018 in Manila, Philippines)
- 15th Regular Session of the Western and Central Pacific Fisheries Commission (organized by WCPFC on 9-14 December 2018 in Hawaii, USA)

SEAFDEC also organized the “Regional Technical Consultation on International Fisheries-related Issues” on 20-22 June 2018 in Bangkok, Thailand with the aim of generalizing the regional common/coordinated approaches by providing a platform for the Member Countries and other relevant key organizations to discuss important international fisheries-related issues, *i.e.* Combating Illegal, Unreported and Unregulated (IUU) Fishing (Port State Measures; Global Record of Fishing Vessels); Small-scale and artisanal fisheries governance (Voluntary Guidelines for Securing Small-scale Fisheries; Labor and Working Conditions and Social Sustainability in Fisheries Value Chains in Fisheries Sectors); Fish trade-related issues (Catch Documentation Scheme (CDS); Biodiversity and CITES-related matters; Impact of Marine Protected Areas on Livelihoods; Food Safety and Quality, and Market Access; Fisheries Subsidies; Inland fisheries; Sustainable aquaculture; Climate change and other environment-related issues; Global and regional ocean process; and Marking of fishing gears to reduce abandoned and lost gears. At the end of the RTC, actions that should be undertaken under the sub-regional and regional levels were identified, and the views of the RTC on the respective issues reflected at the 33rd Session of the Committee on Fisheries (COFI) organized by FAO in July 2018, were compiled for further analysis by SEAFDEC.



*The Regional Technical Consultation on International Fisheries-related Issues
(20-22 June 2018, Bangkok, Thailand)*

In addition to the discussion on international fisheries-related issues, the project also supported the implementation of the ASEAN Catch Documentation Scheme, which is a regionally adopted tool for enhancing the traceability of fish and fishery products. Training and Kickoff Pilot Testing on the eACDS was conducted in Brunei Darussalam; while

introductory visits were made to Myanmar and Viet Nam for possible development in 2019 of key elements in the eACDS that are applicable for these countries.

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

6.1 Extending support and capacity for Member Countries on fishery resource survey

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.”** In 2018, TD collaborated with the Fisheries Administration of Cambodia, the Department of Fisheries of Thailand, the Directorate of Fisheries of Viet Nam, as well as relevant agencies and academic institutions in Thailand to carry out the “Collaborative Research Survey on Marine Fisheries Resources and Marine Environment in the Gulf of Thailand” using the M.V. SEAFDEC 2 from 17 August to 18 October 2018 (*see 1.1 on Assessment and management of marine fish stock*). While the surveys came up with data and information that could support better understanding on the fishery resources, the activities also helped in enhancing the capacity of the Member Countries in the conduct of fishery resource survey in the future.

6.2 Enhancing coordination and networking with the Member Countries

Since the adoption of the Resolution and Plan of Action on Sustainable Fisheries for Food Security in the ASEAN Region Toward 2020, SEAFDEC has enhanced coordination and networking with the ASEAN-SEAFDEC Member Countries in order to provide technical support and monitor the progress made by countries in the implementation of the Resolution and Plan of Action. The project **“Strengthening SEAFDEC Network for Sustainable Fisheries”** was therefore sustained and the “Regional Fisheries Policy Network (RFPN)” which has been upheld by SEAFDEC since 2006, has been enhanced. The RFPN involves the secondment of representatives from the AMSs to the SEAFDEC Secretariat for a period of one year.

In 2018, the six members of the RFPN comprised the Fisheries Officers from Cambodia, Indonesia, Lao PDR, Myanmar, Philippines, and Thailand, four of whom were supported by the SEAFDEC-Sweden Project, and two by the Japanese Trust Fund (JTF). The RFPN members had been playing active roles in enhancing the coordination and communication between SEAFDEC and their respective countries, and are also given the opportunities to attend and provide technical contributions in various events organized by SEAFDEC. The RFPN members also support the efforts of SEAFDEC in developing strategies to promote fisheries policy dialogues, enhance regional and sub-regional cooperation among the Member Countries, and follow-up on the countries’ commitments to implement the Resolution and Plan of Action



The 2018 Regional Fisheries Policy Network members

The project also facilitated coordination with the ASEAN, especially informing them of the works undertaken by SEAFDEC in line with the priority and policy frameworks endorsed by the ASEAN, and submitting the policy documents developed through SEAFDEC initiatives for endorsement under the ASEAN mechanism. Through such partnership, SEAFDEC attended several fisheries-related meetings of the ASEAN in 2018, *i.e.* the 10th Meeting of the ASEAN Fisheries Consultative Forum (AFCF) (7-8 May 2018, Bangkok, Thailand); and the 26th Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGF) (9-12 May 2018 in Bangkok, Thailand). During these meetings, the progress made by SEAFDEC in the implementation of ASEAN fisheries-related policies were also reported.



*SEAFDEC Secretary-General attending in the 26th Meeting of the ASWGF
(9-12 May 2018, Bangkok, Thailand)*

Furthermore, the project also supported the dissemination of results from the activities carried out by SEAFDEC and the Member Countries in line with the Resolution and Plan of Action through the special publication "Fish for the People." Three issues of the publication were published and disseminated in 2018 with these corresponding themes: 1) Aiming for Enhanced Sustainability of Marine Fishery Resources; 2) Promoting Gender Integration in Southeast Asian Fisheries Frameworks; and 3) Positioning Regional Aquaculture and Inland Capture Fisheries to Fill the Global Fish Supply-Demand Gap.



Three issues of SEAFDEC Special Publication published in 2018

7. Special Projects

7.1 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, of which the original project period of five years from January 2013 to December 2017 was extended for two years until 31 December 2019. Also known as the SEAFDEC-Sweden Project, it has the overall objective of achieving sustainable use of aquatic resources and reducing the vulnerability of coastal/rural (fishing) communities in the ASEAN region. Under the Project, several activities have been implemented to build the capacity of the AMSs to be able to achieve the following specific output objectives:

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 the drafting and implementation of regional & sub-regional agreements

The geographical coverage of this Project encompasses four sub-regions of Southeast Asia, namely: the Andaman Sea, Gulf of Thailand, Mekong River Basin, and Sulu Sulawesi Seas. In 2018, the activities focused mainly on the establishment of sub-regional agreements or other arrangements of relevance to fisheries and habitat management; management of fishing capacity; and control and reduction of illegal, unreported and unregulated (IUU) fishing, particularly in the Gulf of Thailand, Andaman Sea, and the Mekong River Basin. In addition, cross-cutting issues, *e.g.* gender in fisheries, small-scale fisheries, environmental issues, and climate change and capacity building, have also been integrated throughout the project implementation.

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

- o *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)*

In 2018, the SEAFDEC-Sweden Project continued to support the AMSs in building their capacities and knowledge in stock assessment of neritic tunas considered as among the most economically important transboundary species in the region through the Implementation of the “Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN (RPOA-Neritic Tunas).” In addition, the population study on longtail tuna (*Thunnus tonggol*) in the Southeast Asian region, carried out by SEAFDEC since October 2017 was continued in 2018 and upon its completion in September 2018, the results were presented at the National Marine Capture Fisheries Symposium in Penang, Malaysia on 2-3 October 2018, and the 8th International Fisheries Symposium (IFS) in Hat Yai, Thailand on 18-21 November 2018. The results would also be presented at the 5th Scientific Working Group on Neritic Tunas scheduled in January 2019 in Bangkok, Thailand.

In furthering the technical findings from the studies undertaken by SEAFDEC into actual practice, the SEAFDEC-Sweden Project also collaborated with the DOF of Thailand and partners in 2018, specifically with the World Wide Fund for Nature of Thailand (WWF-Thailand) and the Thai Tuna Industry Association for the launching of the “Fishery Improvement Project for Longtail Tuna in the Gulf of Thailand.” The initiative is considered as a benchmark step in strengthening the collective and coordinated efforts by linking government agencies, private sector, NGOs, regional organizations, and stakeholders in achieving the common goal towards the long-term sustainability of longtail tuna resources.

SEAFDEC also followed-up the recommendations made by the SEAFDEC Council during its 50th Meeting in 2018 for the possibility of expanding the activities on neritic tunas to other shared stocks of neritic tunas in the region, *i.e.* the Indo-Pacific king mackerel (*Scomberomorus guttatus*) and narrow-barred Spanish mackerel (*Scomberomorus commerson*). The “Practical Workshop on Stock Assessment and Risk Assessment of Indo-Pacific King Mackerel and Narrow-barred Spanish Mackerel in the Southeast Asian Waters” was organized on 16-20 July 2018 in Samut Prakan, Thailand. Through lectures and practical sessions, the Workshop imparted to the participants knowledge on stock assessment analysis of the Indo-Pacific king mackerel and narrow-barred Spanish mackerel using ASPIC, Kobe plot and Risk Assessment based on the sample data provided by the participating countries.



The Practical Workshop on Stock Assessment and Risk Assessment of Indo-Pacific King Mackerel and Narrow-barred Spanish Mackerel in the Southeast Asian Waters (16-20 July 2018, Samut Prakan, Thailand)

o Management of Transboundary Resources/Stocks through Sub-regional Approach

Also through the SEAFDEC-Sweden Project, the sub-regional approach for management of transboundary resources/stocks of identified species was adopted in the Gulf of Thailand and the Andaman Sea Sub-regions. This included the compilation of available information and collection of additional data to support the development of management plans towards the sustainable utilization of the species.

For the ***Gulf of Thailand Sub-region***, the transboundary species targeted were anchovies, mackerels, and blue swimming crab (AIB species). Since 2016, several capacity building activities had been conducted on the species identification and data collection of Indo-Pacific mackerel. In the consultations with countries in the Gulf of Thailand, the workplan in 2018 for DNA collection and analysis for Indo-Pacific mackerel was agreed upon to support better understanding of its stock status. Tissue samples of Indo-Pacific mackerel were collected from Cambodia, Viet Nam, Thailand, and Malaysia from February to April 2018. Subsequently, the tissue samples were analyzed at the Laboratories of Kasetsart University in Thailand. Completed at the end of 2018, results of the DNA analysis were presented during the “Gulf of Thailand Technical Meeting on Management of Transboundary Species: Indo-Pacific Mackerel” on 19-20 December 2018 in Bangkok, Thailand.



Tissue sampling of Indo-Pacific mackerel in Viet Nam



Gulf of Thailand Technical Meeting on Management of Transboundary Species: Indo-Pacific Mackerel (19-20 December 2018, Bangkok, Thailand)

For blue swimming crab, a SEAFDEC-Sweden Project staff attended the Meeting on Management Plan for Blue Swimming Crab in Thailand organized by WWF-Thailand in Phetchaburi Province on 5-6 February 2018, where the current situation of blue swimming crab fisheries was reviewed together with relevant information such as the existing management measures, adaptation, sustainability focusing environment, social and economic considerations, involvement of fisheries community in management, etc. During the meeting, one of the recommendations made by SEAFDEC to supplement the Fisheries Improvement Project for blue swimming crab in Thailand was the application of traceability system for the species, as this would be one of the most effective management tools for the fishery of this species.

For the ***Andaman Sea Sub-region***, the SEAFDEC-Sweden Project organized two meetings in early 2018 with the objectives of identifying the available data from the concerned countries on the priority species, *i.e.* anchovies, mackerels and neritic tunas, which was discussed during the “1st Technical Experts Meeting on Management of Transboundary Species for the Northern Andaman Sea” (between Myanmar and Thailand) on 13-14 March 2018;

and the “1st Technical Experts Meeting on Management of Transboundary Species for the Southern Andaman Sea” (among Indonesia, Malaysia and Thailand) on 4-5 April 2018, both in Bangkok, Thailand. The information that would be compiled, *e.g.* the spawning grounds, spawning seasons, biological data and information, habitats and migration patterns, as well as existing fishing regulations, could support the preparation of maps featuring the life cycles of these priority species covering the area from the Northern to Southern Andaman Sea; and such maps could serve as inputs for the development of coordinated fisheries management measures among concerned countries in this sub-region. As a result, the list of maps to be prepared was agreed, and that data on the priority species should be collected and compiled from relevant agencies, research institutions and academes in the respective countries.

These recommendations were followed-up during the subsequent “2nd Technical Experts Meeting on Information Compilation of Transboundary Species as Scientific Basis for National Measures for Southern Andaman Sea” on 10-11 July; and the “2nd Technical Experts Meeting on Management of Transboundary Species for Northern Andaman Sea” on 12-13 July 2018, both in Chonburi Province, Thailand. The information on digital maps showing the spawning grounds, spawning seasons, biological data and information, habitats and migration patterns, as well as existing fishing regulations of anchovies, mackerels and neritic tunas were reviewed during these Meetings. Nevertheless, since the information compiled was still insufficient, the status of these species could not be confirmed while the agreement for appropriate management could not be reached. It was therefore agreed that data collection should be continued and improved in the respective countries.

o Raising Awareness of Local Communities on Habitats and Fishery Resources Enhancement

The SEAFDEC-Sweden Project in collaboration with “Rak Talay Nomkiao Conservation Group” and local communities in Laem Klad Sub-district and adjacent areas of Trat Bay in Trat Province, Thailand organized a one-day event on 7 October 2018 to promote habitat restoration and fishery resources enhancement in the area. More than 100 persons representing their respective groups took part in sea grass plantation activity as well as in the preparation and deployment of Fish Enhancing Devices (FEDs). Through this activity, the participants fully recognized the need to enhance the fishery resources and the importance of natural habitats to ensure the sustainability of the livelihoods of people that rely on the sustainable utilization of these fishery resources.



Preparation of FEDs (left), and sea grass plantation (right) as part of the project activities to promote habitat restoration and fisheries resources enhancement

Output Objective2: Capacity built and systems improved for the management of fishing capacity (monitoring; record and control)

o Sharing Information and Knowledge on Monitoring and Control and Combating IUU Fishing Across the Countries

There are several challenges that confront Southeast Asian fisheries, either at the regional or sub-regional levels. These include ensuring the effective monitoring and control of the fishing efforts, confirming the legal status of fishing operations, and making sure that catches are properly landed and recorded for the traceability of fish and fishery products throughout the supply chain. These issues are being addressed by the SEAFDEC-Sweden Project by closely linking to the efforts being exerted by the AMSs, SEAFDEC, as well as the regional/international partners, especially with regards to combating IUU fishing.

For the **Gulf of Thailand Sub-region**, the SEAFDEC-Sweden Project conducted two bilateral events that address such challenges. These are the “Bilateral Technical Meeting on Effective Fisheries Management between Thailand and Viet Nam” held on 12-13 June 2018 in Da Nang, Viet Nam; and the “2nd Sub-regional Meeting on Effective Fisheries Management between Cambodia and Thailand” held on 29-30 August 2018 in Koh Kong Province, Cambodia. At the sub-regional level, the “7th Meeting of the Gulf of Thailand Sub-region” was also organized on 1-2 November 2018 in Chonburi, Thailand. During these meetings, information on the respective countries’ legal frameworks had been updated, and the procedures for landing of catch and traceability system applied especially for foreign fishing vessels were established. Discussions were also made on the possibility of and the way forward for the development of MCS networks for the sub-region.

As for the **Andaman Sea Sub-region**, similar discussion was made during the “4th Meeting of the Andaman Sea Sub-region” organized on 20-21 November 2018 in Thailand.



Bilateral Technical Meeting on Effective Fisheries Management between Thailand and Viet Nam (12-13 June 2018, Da Nang, Viet Nam)



The 2nd Sub-regional Meeting on Effective Fisheries Management between Cambodia and Thailand (29-30 August 2018, Koh Kong Province, Cambodia)

o Support of the Establishment of Monitoring, Control and Surveillance (MCS) Networks

In following-up the recommendations from the “1st Sub-regional Consultation on MCS for the Gulf of Thailand” in 2017, the SEAFDEC-Sweden Project stressed on the need to establish the MCS Network(s) as one of the common priorities for the Gulf of Thailand Sub-region to improve transboundary fisheries management and control of fishing efforts

and surveillance across countries in the sub-region. As a result from such Consultation, the SEAFDEC-Sweden Project identified the procedures to support the establishment of sub-regional MCS body which include: 1) national consultation(s); 2) sub-regional meeting(s); and 3) establishment of the sub-regional MCS network.

For the ***Gulf of Thailand Sub-region***, National Consultations were organized in Thailand in July 2018, and in Cambodia on 28 August 2018. Based on the results from these consultations, the “2nd Sub-regional Consultation on MCS for the Gulf of Thailand” will be organized in 2019.



*The National Consultation on MCS
hosted by the Fisheries Administration of Cambodia on 28 August 2018*

Meanwhile, for the ***Andaman Sea Sub-region***, the SEAFDEC-Sweden Project organized the “Meeting on the Development of a Sub-regional Cooperation on Monitoring, Control and Surveillance in Fisheries in the Northern Andaman Sea” on 24-25 July 2018 in Bangkok, Thailand. With officers from relevant national agencies of Thailand and Myanmar in attendance, such as those from the port authorities, fisheries, customs and trade, enforcement authorities, immigration, and labor, the Meeting discussed the common concerns and issues that require cooperation, including the need for information sharing as basis for establishing an MCS network between these two countries. Representatives from Thailand and Myanmar also agreed to enhance the collaboration among concerned national agencies within their respective mandates and responsibilities, and to further strengthen such cooperation for the establishment of the sub-regional MCS network. At the subsequent “4th Meeting of the Andaman Sea Sub-region” on 20-21 November 2018 in Thailand, the countries in this sub-region provided updated information on their existing national MCS system, while the results of the discussion made during the “Meeting on Sub-regional Cooperation on MCS in the Northern Andaman Sea” were also reported. While confirming on the plan to organize a similar meeting on MCS network for the Southern Andaman Sea (among Indonesia, Malaysia and Thailand) in 2019, the Meeting agreed that MCS network coordination should be established to cover the whole area of the Andaman Sea sub-region.



Meeting on the Development of a Sub-regional Cooperation on MCS in Fisheries in the Northern Andaman Sea (24-25 July 2018, Bangkok, Thailand)



The 4th Meeting of the Andaman Sea Sub-region (20-21 November 2018, Bangkok, Thailand)

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

o Strengthening the Sub-regional Cooperation in Target Sub-regions

Discussions on transboundary and sub-regional cooperation on fisheries and habitat management, including measures to monitor and control fishing efforts and landings across borders had progressed in 2018. While the activities for the Gulf of Thailand and Andaman Sea Sub-regions were directly implemented through the SEAFDEC-Sweden Project, for the Mekong River Basin and the Sulu-Sulawesi Seas Sub-regions, initiatives were carried out by relevant partners in these areas, such as the Mekong River Commission (MRC), the USAID-Oceans and Fisheries Partnership (USAID-Oceans), and the Corral Triangle Initiatives on Coral Reefs, Fisheries and Food Security (CTI-CFF), respectively.

For activities in the ***Gulf of Thailand Sub-region***, as previously recommended by the “6th Meeting of the Gulf of Thailand Sub-region” in 2017, the mechanism for bilateral consultations was maintained as it enables the countries to discuss the specific issues relevant to the particular areas. In 2018, the Project convened the “Bilateral Technical Meeting on Effective Fisheries Management between Thailand and Viet Nam” on 12-23 June 2018 in Danang, Viet Nam, followed by the “2nd Sub-regional Meeting on Effective Fisheries Management between Cambodia and Thailand” on 29-30 August 2018 in Koh

Kong, Cambodia. In addition, during the “7th Meeting of the Gulf of Thailand Sub-region” organized on 1-2 November 2018, discussion and agreement were made on the need for continued and strengthened Gulf of Thailand sub-regional information sharing in support of the management of transboundary fish stocks, monitoring and management of fishing capacity and combating illegal fishing, as well as follow-up on the progress of the initiative to establish MCS networks by building upon the existing national MCS mechanisms.

For the **Andaman Sea Sub-region**, the Project successfully facilitated the discussion between Thailand and Myanmar in the Northern Andaman Sea on several areas of mutual interest, including the aspects on management of transboundary stocks, combating IUU fishing, and the establishment of sub-regional MCS coordination efforts. In parallel with the activities in the Northern Andaman Sea, the Project also facilitated dialogues for the countries around the Southern Andaman Sea, namely Indonesia, Malaysia and Thailand, by conducting meetings for the compilation of available information that form the basis for the development of the digitized maps of spawning grounds, nursery grounds, migration patterns and fishing areas of anchovies, mackerels and neritic tunas. The Project also facilitated the consultation on the MCS networking in the Southern Andaman, the process of which is still on-going. The relevant efforts were reported to the “4th Meeting of the Andaman Sea Sub-region” on 20-21 November 2018 in Thailand.

For the **Mekong River Basin Sub-region**, the activities focused on enhancing the coordination between Lao PDR and Thailand. In 2018, fishing gear surveys were conducted in Bo Keo, Lao PDR, and Chiang Rai Province, Thailand, the results of which were presented and discussed during the “Bilateral Technical Meeting on Effective Fisheries Management between Lao PDR and Thailand” on 29-30 October 2018 in Chiang Rai Province, Thailand, as these could serve as basis for promoting cooperation between the two countries in monitoring and control of fishing in the area, and balancing the use of available resources with the need for protection of critical habitats. The Meeting also provided directions for strengthening the transboundary resources management and conservation including monitoring and control of fishing efforts corresponding to the existing fishing efforts and availability of resources in Bo Keo and Chiang Rai.



*Conduct of fishing gear surveys in
Bo Keo, Lao PDR*



*Bilateral Technical Meeting on Effective Fisheries
Management between Lao PDR and Thailand
(29-30 October 2018, Chiang Rai Province, Thailand)*

For the **Sulu-Sulawesi Seas Sub-region**, the project in 2018 continued to keep track of the initiatives supported through the CTI-CFF and the USAID Oceans. Meetings were regularly held with USAID Oceans to acquire updates on the progress and the planned future activities.

o Gender and Social Development and Promotion of the Small-scale Fisheries Guidelines

In 2018, the Project made good progress in the integration of gender in project implementation, provision of institutional capacity building at SEAFDEC, and enhancing the cooperation with other partners toward the promotion of gender equality in the fisheries sector.

The **Regional Gender Study** which commenced in 2017 as a joint effort of the Mangroves for the Future (MFF), Stockholm Environment Institute (SEI), and SEAFDEC-Sweden Project was successfully completed in 2018. Data collection on gender patterns in coastal and marine resources management was undertaken in Kep Province of Cambodia, Trat Province of Thailand, and in Kaw Thauung Province of Myanmar. Results of the study were presented during the “Regional Dialogue on Gender Dimension in Coastal and Fisheries Resources Management in South Asia and Southeast Asia: Opportunities and Challenges” on 15-16 November 2018 in Bangkok, Thailand. While the Study has deepened the understanding on the gender dimension in coastal and fisheries resources management, during the Regional Dialogue, discussion was also made on how structural challenges are preventing the equitable opportunities for men and women in South Asia and Southeast Asia.

The FAO Gender Focal Persons from FAO/Rome and FAO/Regional Office in Bangkok attending the Regional Dialogue also shared their knowledge on gender-equity in small-scale fisheries by enhancing the understanding of their gender dimensions, with focus on the specific roles and conditions of women in the small-scale fisheries sub-sector. The resource person from Women Organizing for Change in Agriculture and Natural Resource Management (WOCAN) also shared the information regarding the “W+ Standard” which can be applied to projects or programs to increase rigor and accountability of gender programs, incentivize new investments in women’s empowerment, and create a market-based results-based financing mechanism.



Regional Dialogue on Gender Dimension in Coastal and Fisheries Resources Management in South Asia and Southeast Asia: Opportunities and Challenges (15-16 November 2018, Bangkok, Thailand)

From the Regional Gender Study in Cambodia, Thailand and Myanmar, **Gender Analysis** was undertaken at the site levels to support capacity building of staff and researchers involved in the Study. The following are the series of workshops conducted for Gender Analysis:

- o Data Analysis Workshop on Gender Dimension in Fishery Management in Coastal Communities in Cambodia, Myanmar and Thailand (6-9 February 2018, Bangkok, Thailand) (facilitated by SEI)
- o Training Workshop on Gender Analysis in Fisheries Sector for SEAFDEC Gender Working Team (GWT) (5-8 March 2018, SEAFDEC Secretariat, Bangkok, Thailand) (facilitated by WOCAN)
- o Survey on Socio-economic and Livelihood Status Integrated with the Gender Dimensions (19-27 January 2018, Kaw Thaug, Myanmar)
- o Workshop on Data Validation on Social Profile, Market Channel with Gender Dimension (19 April 2018, Kaw Thaug, Myanmar)
- o Gender Data Validation and Analysis Workshop (30 April-4 May 2018, Kep Province, Cambodia)
- o Survey on Social Profile, and Livelihood of Fishing Communities, Marketing and Gender Perspectives Information (5-12 November 2018, Ranong Province, Thailand)

Outputs from Gender Analysis of selected sites were presented at the “6th Marine Science Conference” on 16-20 June 2018 in Chonburi Province, Thailand; the “Gender in Aquaculture and Fisheries (GAF7) Conference” on 18-21 October 2018 at AIT in Pathum Thani, Thailand; and 3) the “3rd World Small-Scale Fisheries Congress” on 22-26 October 2018 in Chiang Mai, Thailand.



Data collection on gender dimensions in Kaw Thaug Province, Myanmar



Validation of data on gender in Kep Province, Cambodia

From the data collection and analysis on gender in fisheries, the SEAFDEC-Sweden Project continued with the next step by **“developing the gender assessment toolkit”** which could be applied by researchers of SEAFDEC as well as those of other agencies/organizations in the region in the future conduct of gender assessment. The draft toolkit was discussed during the “Experts Consultation Workshop on Guidance to Monitoring and Evaluation of Gender Equity and Social Well-being in Fisheries Communities” on 8-10 August 2018 in Bangkok, Thailand. Using the key components of the “FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines)” as basis, key indicators and guide questions were identified, and once this is developed, such toolkit could be used to support the monitoring and evaluation of gender equity and social well-being in fisheries communities.



The Experts Consultation Workshop on Guidance to Monitoring and Evaluation of Gender Equity and Social Well-being in Fisheries Communities (8-10 August 2018 in Bangkok, Thailand)

In order to sustain the initiatives and to further integrate the gender concept at the organizational level, the SEAFDEC Secretariat proposed during the 50th Meeting of the SEAFDEC Council on 26-30 March 2018, in Siem Reap, Cambodia the development of **“SEAFDEC Gender Strategy.”** The proposal was agreed by the SEAFDEC Council, considering that the SEAFDEC Gender Strategy would provide an overarching framework to facilitate SEAFDEC’s efforts toward integrating gender in its future programs and projects, which would eventually support the integration of gender perspectives in fisheries in the respective countries.

To proceed on the development of SEAFDEC Gender Strategy, SEAFDEC convened an “Inter-Departmental Meeting on Development of SEAFDEC Gender Strategy” on 3-4 September 2018 in Bangkok, Thailand. Discussed among the Gender Working Team comprising members from SEAFDEC Secretariat and TD, and in consultation with the SEAFDEC Gender Focal Persons from the AQD, MFRDMD and IFRDMD, the meeting came up with the first draft of the “SEAFDEC Gender Strategy” which was presented to the 41st Meeting of SEAFDEC Program Committee in November 2018 in Malaysia, and was supported for further submission to the 51st Meeting of the SEAFDEC Council in 2019 for consideration.



The Inter-Departmental Workshop for Development of SEAFDEC Gender Strategy (3-4 September 2018, Bangkok, Thailand)

The SEAFDEC-Sweden Project also continued the initiative related to the **Promotion of the Small-scale Fisheries Guidelines in Relevance to Gender and Human Rights-based Approach.** In 2018, the “Policy Brief: Applying Human Rights-based and Gender Equality Approaches to Small-scale Fisheries in Southeast Asia” which was previously prepared through the Experts Workshop in 2017 was supported by the SEAFDEC Council, and the Policy Brief was disseminated to enhance public understanding and awareness on the approach being advocated.

o Labor, Working Conditions and Safety at Sea

Labor, working conditions and safety at sea is another important cross-cutting element for the promotion of sustainable fisheries. In 2018, the SEAFDEC-Sweden Project was represented at the fora organized by the International Labour Organization (ILO) to maintain dialogue with ILO and FAO with the principle that labor issues should be addressed through the appropriate ASEAN mechanism. The first event was the “Regional Technical Seminar on Joining Forces in the Fisheries Sector: Promoting safety, decent work and the fight against IUU fishing” organized by FAO, Apostleship of the Sea, ILO and IMO from 21 to 22 March 2018, in Manila, Philippines. At this Seminar, SEAFDEC presented the results and recommendations of the “Regional Technical Consultation on Labor Aspects within the Fishing Industry in the ASEAN Region” organized by SEAFDEC-Sweden Project since 2016. The second event was the “Consultative Forum on Regional Cooperation against Human Trafficking, Labour Exploitation, and Slavery at Sea” on 27-28 March 2018 in Bali, Indonesia. Organized under the ILO SEA project, the Consultation aimed to strengthen coordination to combat labour exploitation and trafficking in fisheries in Southeast Asia by building consensus on the mandate, structure and role of the Regional Cooperation Mechanism, and identify priority areas of action in regards to human trafficking, labor exploitation, and slavery at sea. During the Forum, the SEAFDEC-Sweden Project promoted its relevant work in setting up of MCS network, and urged for the incorporation of regional coordination on labor issues into the MCS process.

o Enhancing Coordination through the Regional Fisheries Policy Network (RFPN)

In 2018, the SEAFDEC-Sweden Project supported four officers from national fisheries agencies of Indonesia, Myanmar, Thailand, and Philippines, to form part of the RFPN, while two officers, one each from Cambodia and Lao PDR, were supported by the Japanese Trust Fund. On an annual basis, staff members from fisheries agencies of ASEAN Member Countries are posted at the SEAFDEC Secretariat for one year. The RFPN members play an active role in enhancing coordination and communication between SEAFDEC and their respective countries while also being given the opportunity to attend and provide technical contributions in various events organized by SEAFDEC.

o Coordination with Other Organizations and Projects

One of the very important elements of the SEAFDEC-Sweden Project is strengthening cooperation and networking with other regional and international partners with the aim of enhancing regional cooperation and ensuring the long-term sustainability of the initiatives promoted through the Project. Such cooperation with partners was built up through the facilitation of initiatives at regional and sub-regional levels for the Gulf of Thailand, Andaman Sea, Mekong River Basin, and Sulu Sulawesi Seas.

In 2018, the project closely coordinated with the FAO Headquarters as well as through its Regional Office in Bangkok (FAO/RAP) and the Asia Pacific Fisheries Commission (APFIC); the Secretariat of 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 shared information with several organizations and projects such as the Swedish Agency for Marine and Water Management (SwAM), the USAID-Oceans, the International Labour Organization (ILO), as well as other

projects of SEAFDEC that are supported by other sources, *e.g.* the Japanese Trust Fund (JTF) and the SEAFDEC/UN Environment/GEF/Fisheries *Refugia* Project.

In addition, the project coordinated closely with the Mangroves for the Future (MFF)/IUCN in several aspects of work, such as transboundary areas management around Gulf of Thailand as well as in the conduct of the Regional Gender Study, which involved not only MFF, but also with the Stockholm Environment Institute (SEI).

o Support to Local Partners

In 2018, the SEAFDEC-Sweden Project continued to support the Sustainable Development Foundation (SDF) in the implementation of the activity “Toward Ecosystem-based Approach to Fisheries Management in Trat Bay” which was started in July 2017. Upon the completion of this activity in June 2018, the key achievements were reported that include: capacity built for small-scale fishing communities on improved behavior to engage in fisheries management and marine coastal resources conservation, support extended for the establishment of small-scale fishers’ association of Trat Province, and promotion of coastal resources conservation zones.

For the collaboration with other local partners, *e.g.* CORIN-Asia Cambodia and Learning Institute (LI), the Project in collaboration with the Fisheries Administration of Cambodia in partnership with the CORIN-Asia Cambodia and LI co-organized the “National Forum on Fisheries and Habitat Management, Climate Change and Social Well-being” on 3-4 December 2018 in Phnom Penh, Cambodia. The Forum aimed to: 1) disseminate experiences and lessons learnt from local implementation to relevant stakeholders; 2) raise awareness on inland and coastal communities’ livelihood and fishery and aquatic ecosystem; and 3) enhance the relationship among the government, organizations, and fishing communities.



National Forum on “Fisheries and Habitat Management, Climate Change and Social Well-being” to disseminate the best practices and lessons learnt from inland coastal communities (3-4 December 2018, Phnom Penh, Cambodia)



Sharing of experiences on crab bank activities in Cambodia

7.2 Oceans and Fisheries Partnership

Launched since 2015, the “**USAID Oceans and Fisheries Partnership**” or “USAID Oceans” aims to strengthen regional cooperation to combat illegal, unreported, and unregulated (IUU) fishing, promote sustainable fisheries, and conserve marine biodiversity in the Asia-Pacific region. Specifically, the USAID Oceans works towards: 1) strengthening regional

cooperation and capacity to combat IUU fishing and conserve marine biodiversity; 2) expanding the use of electronic Catch Documentation and Traceability (eCDT) systems to priority biodiversity areas; 3) strengthening the capacity of regional and national organizations to conserve biodiversity using an EAFM and eCDT; 4) addressing human welfare concerns, including gender and labor across all program activities and 5) engaging the private sector to ensure sustainability, while advancing regional fisheries governance.

In 2018, the project continued its activities in two pilot learning sites: 1) General Santos, Philippines; and 2) Bitung, Indonesia. In carrying out its activities, the USAID Oceans coordinated closely with the Philippine Bureau of Fisheries and Aquatic Resources (BFAR), and Indonesia's Ministry of Marine Affairs and Fisheries (MMAF) in implementing and planning the specific national and learning site activities, particularly the implementation of the eCDT system, with expansion to other countries to support the development and adoption of the eCDT systems in the future. Two CDT leadership publications 1) Data Requirements for Catch Documentation and Traceability in Southeast Asia: Critical Tracking Event and Key Data Element Framework and Glossary or the "KDE Manual" for short; and 2) Fisheries Catch Documentation and Traceability in Southeast Asia: Technical Specifications or the "CDT 201" were developed and promoted to serve as guide on the USAID Oceans' approach to system design, development and technical specifications—as well as identify the key data elements required for full end-to-end traceability.

Moreover, the "Third Technical Working Group Planning Workshop" organized from 16 to 18 July in Bangkok, Thailand, came up with 1) TWG endorsement of a process and outline related to the development of proposed set of regional guidelines for the ASEAN-wide implementation of eCDT systems; 2) documented input from TWG members regarding current and future regional priorities that will inform the future direction of USAID Oceans during the second half of the project life span, as well as US-supported development initiatives beyond USAID Oceans; and 3) documented input on USAID Oceans' Year Four Activity Work Plan.



The Third Technical Working Group Planning Workshop (16-18 July 2018, Bangkok, Thailand)

SEAFDEC PROGRAMS FOR 2019

The programs/projects to be implemented by SEAFDEC in 2019 was scrutinized and endorsed by the SEAFDEC Program Committee during its 41st Meeting (5-7 November 2018, Langkawi, Malaysia). These programs/projects could be categorized as: 1) Projects under the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) Mechanism; 2) Departmental Programs; and 3) Other Programs. The lists of programs and projects appear as follows:

1) Projects under the FCG/ASSP Mechanism

Strategy/Project Title	Lead Department	Funding Source
Strategy I: Securing the sustainability of fisheries to contribute to food security, poverty alleviation and livelihood of people in the region		
<p>1. Human Resource Development for Sustainable Fisheries (2013-2019)</p> <p>This Project has the objective of strengthening the knowledge and skills of key national officers toward sustainable fisheries development, with particular focus on improving fishers' well-being and incomes through adding value to their catch. Since 2013, the Project has been conducting a series of training courses on Ecosystem Approach to Fisheries Management (EAFM) for Myanmar, Cambodia, Lao PDR, and Thailand. This was followed by the implementation of activities to improve the well-being and incomes of target communities at the project sites in Cambodia, Myanmar, and Lao PDR. As 2019 is the final year of this Project, a workshop would be organized to summarize the Project results and achievements, and facilitate the exchange of experiences from the activities implemented in different project sites, as well as similar initiatives undertaken by other projects and organizations. Furthermore, the training materials on EAFM would also be improved in collaboration with partner organizations, such as the USAID and NOAA.</p>	TD	JTF
<p>2. Optimizing Energy Use/Improving Safety Onboard Vessels in Fishing Activities (2013-2019)</p> <p>With the objectives of developing appropriate technologies, transferring knowledge and enhancing awareness on optimizing energy use in fishing activities, and promoting safety at sea for smallfishing vessels in the Southeast Asian countries, the Project has been implemented since 2013 by making use of the FAO/ILO/IMO publication "Safety</p>	TD	JTF

<p>Recommendations for Decked Fishing Vessels of Less Than 12 Metres in Length and Undecked Fishing Vessels” translated into the national languages of Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam. In 2019, a regional training on optimizing energy and safety at sea for fishing vessels would be conducted, while improvement of storage facilities on purse seine tuna vessel would also be pursued.</p>		
<p>3. Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia (2013-2019)</p> <p>The Project is aimed at obtaining information on fishery resources enhancement and habitat conservation measures in Southeast Asia; supporting human resources development for implementing fishery resources enhancement and habitat conservation measures; and promoting good practices on fishery resources enhancement and habitat conservation measures suitable for the region. During the Project’s final year, which is in 2019, a workshop/experts consultation on suitable measures for sustainable fisheries resource enhancement and habitat conservation activities would be organized. Information on the rehabilitation of fisheries resources and habitats/fishing grounds would be disseminated to the stakeholders to enhancing public awareness. Furthermore, a workshop/experts consultation on hilsa resources would be organized for Myanmar and Thailand.</p>	TD	JTF
<p>4. Enhancement of Sustainability of Catadromous Eel Resources in Southeast Asia (2015-2019)</p> <p>The Project comprises activities that aim to obtain clear understanding of the status of resources, fisheries, and utilization of catadromous eels in the region; improve data collection and statistics of catadromous eel catch in the AMSs; and enhance the knowledge and capacity of the AMSs for the conservation, management and sustainable utilization of catadromous eel resources. Based on the data compiled under this Project during the past years, the workshop to be organized in 2019 intends to come up with guidelines on the conservation, management and sustainable utilization of catadromous eel resources in the region. The guidelines would be promoted in the AMSs to enhance public awareness.</p>	IFRDMD	JTF

<p>5. Promotion of Responsible Utilization of Inland Fisheries in Southeast Asia (2015-2019)</p> <p>The Project is aimed at reviewing the activities and methodologies for promoting inland fisheries in the AMSs; promoting effective inland fisheries management measures in the AMSs; and studying and developing habitat conservation/resources enhancement measures that are suitable for the region. As the Project activities would be continued in 2019, a publication summarizing the features on inland fisheries in the Southeast Asian region would be published, and a workshop would be convened to develop policy recommendations on responsible inland fisheries resources utilization in the region.</p>	IFRDMD	JTF
<p>6. Promotion of Countermeasures to Reduce IUU Fishing Activities (2013-2019)</p> <p>The Project focuses on two approaches toward combating IUU fishing activities in the Southeast Asian region, <i>i.e.</i> development and promotion of the regional fishing vessels record (RFVR); and strengthening the implementation of Port State Measures (PSM) and other surveillance measures. While updating the RFVR Database for fishing vessels 24 meters in length and over would be updated in 2019, the Project would explore the possibility of enhancing the utilization of the Database and expanding the RFVR to also cover vessels smaller than 24 meters in length. The project would also continue to facilitate regional cooperation and capacity building for AMSs' officers towards effective implementation of the PSM in the region; as well as to support the promotion of the ASEAN Catch Documentation Scheme (ACDS) in SEAFDEC Member Countries, namely Brunei Darussalam, Viet Nam, Myanmar, Malaysia, and Thailand.</p>	TD	JTF
<p>7. Establishment and Operation of a Regional System of Fisheries <i>Refugia</i> in the South China Sea and Gulf of Thailand (2016-2020)</p> <p>The Project is implemented in six participating countries, namely Cambodia, Indonesia, Malaysia, Philippines, Thailand, and Viet Nam, with the objective of operating and expanding the network of fisheries <i>refugia</i> in the South China Sea and Gulf of Thailand for improved management of fisheries and critical marine habitats linkages. In 2019, the fisheries <i>refugia</i> profile reports would be published, including GIS maps and site characterisations of 14 priority <i>refugia</i> sites in the six countries. Activities aimed towards improving the management of critical habitats</p>	TD	UNEP/ GEF

<p>for fish stocks of transboundary significance <i>via</i> national and regional actions would be continued to strengthen the enabling environment and knowledge-base for fisheries <i>refugia</i> management in the South China Sea and the Gulf of Thailand.</p>		
<p>8. Offshore Fisheries Resources Exploration in Southeast Asia (2014-2019)</p> <p>The Project aims to provide technical support to the Member Countries in exploring the under-utilized fishery resources beyond their respective coastal zone through the conduct of fisheries research and oceanographic surveys; and support human resources development on fisheries and oceanographic research surveys, onboard navigation, and marine engineering training and fish handling onboard fishing vessels. In 2019, a training workshop on tuna stock assessment for yellowfin tuna, bigeye tuna and skipjack tuna resources in the Sulu-Sulawesi Seas would be organized. In continuing the analysis of the stock structure, a training on the stock structure of tuna using otolith would be organized in Malaysia and Philippines while the otolith samples from Indonesia would be sent to Japan for analysis. Furthermore, regional activities on improvement of fish handling at sea, onshore and onboard fishing vessels would be carried out.</p>	TD	JTF
<p>9. Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region (2013-2019)</p> <p><i>Sub-project I: Improving the Data Collection of the Commercially-exploited Aquatic and Threatened Species.</i></p> <p>The Sub-project is aimed at enhancing the capability of the Member Countries in compiling and utilizing fishery statistics and information on sharks and rays at species level in order to fulfill the Non-detriment Findings (NDFs) documents; supporting the Member Countries in their efforts to develop their respective NPOAs for sharks and rays; and providing scientific evidence for sustainable management of sharks and rays fisheries in the region. In 2019, capacity building on age determination using the vertebra of sharks and rays would be conducted; while sharks and rays data collection would be undertaken at the pilot sites in: Songkhla (Thailand) and Tawau (Sabah, Malaysia) for demersal sharks, and in Cilacap (Indonesia) for pelagic sharks.</p>	TD	JTF

<p><i>Sub-project II: Facilitating Fisheries Activity Information Gathering through Introduction of Community-based Resources Management/Co-management</i></p> <p>The Sub-project aims to review the problems and constraints, and identify the key issues in fisheries data collection in coastal small-scale and inland fisheries at the national level in support of the relevant efforts of the Member Countries. Capacity building would be sustained through the conduct of the on-site training relevant to “Facilitating Fisheries Information Gathering Through Introduction of Community-based Resources Management/Co-management” in the Member Countries. In 2019, the Project would be continued at Nam Xouang Reservoir and Khammouane Province in Lao PDR, and at Nam Oon Dam, Sakon Nakhon Province in Thailand. A regional workshop would be organized in 2019 to review the problems and constraints in promoting CBRM/Co-management in coastal small-scale and inland fisheries, and come up with guidelines/toolkit for improving the collection of fisheries information.</p>		
<p>10. Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region (2013-2019)</p> <p>The Project is aimed at compiling the CPUE data available in the countries of the region (<i>i.e.</i> Malaysia and Thailand), comparing the purse seine fisheries management systems/ measures including the TAC systems and other management measures in the world, conducting genetic study of a commercially important pelagic species (<i>Amblygaster sirm</i>), and developing management strategies for sustainable purse seine fisheries in the Southeast Asian region. In 2019, a synthesis of the regional information on purse seine fisheries would be continued taking into account the updated data provided by the Member Countries in 2018, while the information on stock levels and appropriate applicable management strategies for sustainable purse seine fisheries in the Southeast Asian region would be compiled. The findings would be published in the Project terminal report.</p>	MFRDMD	JTF
<p>11. Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region (2015-2019)</p> <p>The Project has the objectives of training technical officers in the participating Member Countries to enable them to collect taxonomic and biological data on sharks and rays in their respective countries; obtaining genetic information for shark and ray species in the region identified through</p>	MFRDMD	JTF

<p>DNA barcoding; and collecting information on the utilization of sharks and rays in the region for proper fishery management and sustainable utilization. As the compilation of sharks and rays biological information, catch data, and tissue samples would be continued in the participating countries, a workshop on the identification of sharks and rays in the region would be organized in 2019. Report of the survey on fishers' dependencies, marketing and trade of sharks and rays in Java and Sumatera, Indonesia would also be published.</p>		
<p>12. Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia (2017-2019)</p> <p>The Project has the overall objective of strengthening and consolidating eel resource management framework for sustainable provision of eel products and management of eel capture fisheries/eel farming in the AMSs. Towards this objective, the activities to be carried out include: survey of catch and aquaculture production statistics in countries having eel fisheries and aquaculture activities; survival rate survey of eel aquaculture; and conduct of regional events to consolidate the project outputs. In 2019, the Project would be continued with the statistical survey on the utilization status of Anguillid eel resources and DNA analysis to clarify the species identification, habitat and species composition of Anguillid eels; and identification of factors that contribute to the low survival rate of juvenile eels. A series of events would also be conducted, namely: a regional meeting; resources management workshop; and statistics workshop.</p>	SEC	JAIF
<p>13. SEAFDEC-EU/CITES Sharks Project Phase II (2018-2019)</p> <p>The objective of the second phase of this Project supported by the EU-CITES is to continue supporting the AMSs in the development of the NDF documents to fulfill the CITES provisions for trade in Appendix-II-listed sharks and rays. As capacity building activities had been conducted in Cambodia, Myanmar, and Viet Nam in 2018, these countries would proceed with the completion of their one-year shark data collection in 2019 to support the development of NDF documents. In 2019, a capacity building activity would also be conducted in the Philippines; and a set of regional references in the development of shark NDFs would be compiled. Information package developed through this project would also be disseminated at relevant regional and international fora including the CoP18-CITES.</p>	SEC	EU-CITES

<p>14. Strengthening the Effective Management Scheme with GIS (Geographic Information System) & RS (Remote Sensing) Technology for Inland Fisheries and Aquaculture at AMS (2019)</p> <p>The one-year project would comprise activities on the collection and compilation of the amount of catch data by fishing ground and environmental data on the geographical and inland water aquatic organism habitats. Such data would be analyzed to clarify relationship among the geographical and environmental data, and summarized into a document that take into account the results of catch monitoring method using GIS mapping/RS technology. The project activities would start in 2019 at pilot sites in: Thailand, Lao PDR, Cambodia, Indonesia, and Myanmar.</p>	<p>TD</p>	<p>JAIF</p>
<p>Strategy II: Supporting the sustainable growth of aquaculture to complement fisheries and contribute to food security, poverty alleviation and livelihood of people in the region</p>		
<p>15. Environment-friendly, Sustainable Utilization and Management of Fisheries and Aquaculture Resources (2015-2019)</p> <p>The Project is aimed at establishing environment-friendly, responsible aquaculture technology; and promoting community-based production and resource enhancement of high-value aquatic resources; and disseminating and demonstrating such resource enhancement practices. In 2019, the activities will cover the scopes on: use of plant-based protein sources in tilapia feeds for improved production traits; responsible aquaculture through aquasilviculture; promotion of community-based production and resource enhancement of high-value aquatic resources, <i>e.g.</i> abalone <i>Haliotis asinina</i>, sea cucumber <i>Holothuria scabra</i>, and seahorses <i>Hippocampus</i> spp.; and conduct of marine fish hatchery training and rural aquaculture programs.</p>	<p>AQD</p>	<p>JTF</p>
<p>16. Reinforcement and Optimization of Fish Health Management and the Effective Dissemination in the Southeast Asian Region (2015-2019)</p> <p>The project would continue to aim for the development and acceleration of rapid and effective fish and shrimp health management, <i>e.g.</i> for WSSV and EMS; enhancing the efficacy of vaccine treatment in tropical cultured species <i>e.g.</i> for NNV; establishment of protective measures against persistent and emerging parasitic diseases of tropical fish; identification of risk factors and development of protective measures against Early Mortality Syndrome (EMS); and extending and demonstrating the technology to practitioners, officers, etc. of the Member Countries.</p>	<p>AQD</p>	<p>JTF</p>

Strategy III: Ensuring the food safety and quality of fish and fishery products for the Southeast Asian region		
<p>17. Chemicals and Drug Residues in Fish and Fish Products in Southeast Asia – Biotoxins (ASP, AZA and BTX) and Harmful Algal Bloom (HABs) in the ASEAN region (2013-2019)</p> <p>The Project aims to upgrade the regional laboratory capabilities for testing of biotoxins and identification of HABs, and establish monitoring programs for the Member Countries. In 2019, the project would publish the Technical Compilation that comprises information on biotoxins analytical methods and biotoxins monitoring survey reports of the Member Countries; the methodologies for the isolation, culturing, preservation, identification and monitoring of toxic HAB species; country reports on toxic HAB occurrences, incidences and management of toxic HABs; and the region’s directory of responsible national authorities and HAB experts. The End-of-Project (EOP) Meeting will also be convened in the 3rd quarter of 2019.</p>	MFRD	JTF
Strategy IV: Enhancing trade and compliance of the region’s fish and fishery products with market requirements		
<p>18. Combating IUU Fishing in the Southeast Asian Region through Application of Catch Certification for Trading of Fish and Fishery Products (2013-2019)</p> <p>Illegal, unreported and unregulated (IUU) fishing has been identified as the biggest threat to the sustainable development of fisheries and aquaculture all over the world. The “ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain” was therefore developed with the Project supporting the implementation of the Guidelines by the ASEAN Member States, particularly through pilot projects for implementing the ASEAN Catch Documentation Scheme (ACDS) in the Member Countries, <i>e.g.</i> Brunei Darussalam. These activities would be continued in 2019 which is the final year of this Project. In addition, the promotion of the ACDS would also be expanded to cover Viet Nam, Myanmar, Malaysia, and Thailand.</p>	MFRDMD	JTF
Strategy V: Addressing cross-cutting issues, such as labor, gender and climate change, where related to international fisheries		
<p>19. Assistance for Capacity Building in the Region to Address International Fisheries-related Issues (2013-2019)</p> <p>The Project aims to facilitate monitoring of emerging international fish trade-related issues, environment-</p>	SEC	JTF

<p>related issues and fisheries-related issues that may impact the region's fisheries sector; and provide support to the Member Countries in the development of regional common/coordinated positions for addressing such issues. In 2019, the project would continue to monitor the emerging international issues, and support the development of region's views to be reflected at relevant fora, <i>e.g.</i> FAO and ASEAN fora related to fisheries, CoP18-CITES. The project would also support the adoption of regional policy documents, <i>e.g.</i> the ACDS, RPOA-Capacity, RPOA-Neritic Tunas, and enhance awareness and disseminate the outputs from the implementation of such policies.</p>		
<p>Strategy VI: Empowering SEAFDEC to strengthen its roles in the region and to improve its services to Member Countries</p>		
<p>20. Fisheries Resource Survey & Operational Plan for M.V. SEAFDEC 2 (since 2004)</p> <p>In 2004, the M.V. SEAFDEC 2 was granted by Government of Japan to SEAFDEC to support the SEAFDEC Member Countries in their efforts to conduct fisheries resources and marine environmental surveys. The Project was therefore formulated with the objectives of assisting the Member Countries in conducting fisheries research resources surveys, and building human resources capacity through the utilization of the M.V. SEAFDEC 2. For 2019, the Member Countries that requested to use the M.V. SEAFDEC 2 include Viet Nam for the conduct of a survey of marine fisheries in Viet Nam, and Malaysia for its mid-water trawl survey in Malaysian waters.</p>	<p>TD</p>	<p>JTF and AMSs under cost-sharing scheme</p>
<p>21. Strengthening SEAFDEC Network for Sustainable Fisheries</p> <p>The Project is expected to come up with: 1) enhanced regional coordination and collaboration; 2) strengthened monitoring and evaluation of the SEAFDEC programs and projects; and 3) strengthened information dissemination of SEAFDEC projects results. Towards achieving such outcomes, the project in 2019 would continue to support regional coordination through the Regional Fisheries Policy Network (RFPN); enhance cooperation among SEAFDEC and Member Countries on the results of FCG/ASSP programs; facilitate monitoring and evaluation of SEAFDEC programs/project activities; and promote the results of initiatives undertaken by SEAFDEC through the special publication "Fish for the People."</p>	<p>SEC</p>	<p>JTF</p>

Special Projects		
<p>22. Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia (2013-2019)</p> <p>The Project aims to achieve three output objectives, namely: 1) capacity built for the integration of habitat and fisheries management, and adaptation to climate change; 2) capacity enhanced and systems improved for the management of fishing capacity (monitoring; record and control);and 3) capacity built and policy development processes improved for drafting and implementing regional and sub-regional agreements. Four sub-regions targeted by this project include the Gulf of Thailand, Andaman Sea, Mekong River, and Sulu-Sulawesi Seas. In 2019, the project would continue to conduct various activities, <i>e.g.</i> sub-regional meetings, consultations and workshops, based on the thematic issues; and wrap-up on the lessons learned from the implementation of the relevant activities in the four sub-regions. The Project would also support regional cooperation to promote sustainable utilization of neritic tuna resources in Southeast Asia waters through the conduct of the 5th Meeting of the Scientific Working Group, and improve data collection on neritic tunas. Cooperation with other international organizations including their participation to the relevant events would be continued with a view of enhancing the project visibility and impacts; while support to the Regional Fisheries Policy Network (RFPN) would also be sustained.</p>	SEC	Sweden
<p>23. The Oceans and Fisheries Partnership (USAID Oceans) (2015-2020)</p> <p>The Project has the objectives of: 1) strengthening regional cooperation and capacity to combat IUU fishing and conserve marine biodiversity; 2) expanding the use of electronic Catch Documentation and Traceability (eCDT) systems to priority biodiversity areas; 3) strengthening the capacity of regional and national organizations to conserve biodiversity using an Ecosystem Approach to Fisheries Management (EAFM) and eCDT; 4) addressing human welfare concerns, including gender and labor across all program activities; and 5) engaging the private sector to ensure sustainability, while advancing regional fisheries governance. Activities in 2019 would be continued at the two learning sites in General Santos, Philippines, and in Bitung, Indonesia. In addition, activities would also be continued at the identified expansion sites in Malaysia and Thailand.</p>	TD	USAID

2) Departmental Programs

Program Title	Department	Funding Source
<p>1. Quality Seed for Sustainable Aquaculture (2016-2020)</p> <p>The Program aims to generate, verify and promote technologies to ensure the sustainable production of quality seedstock for aquaculture as well as for stock enhancement.</p> <p>The Program would also continue to focus on one of the main objectives, which is to help industry stakeholders, particularly those engaged in small to medium scale aquaculture operations by introducing the innovations discovered through science-based researches.</p> <p>In 2019, the Program will continue with such activities as the use of agricultural wastes as feed ingredients for Nile tilapia and development of nursery rearing techniques for the Anguillid eels. Plans to collaborate with Philippine academic institutions (e.g. Central Luzon State University (CLSU), De La Salle University (DLSU), University of the Philippines' Marine Science Institute (UP MSI)) on (a) genomic applications for aquaculture stock improvement, and (b) development of functional feeds particularly for tilapia and mangrove crabs, shall commence should funds from the Department of Science and Technology (DOST) be successfully obtained.</p> <p>The studies on catfish, Anguillid eel, silver therapon, giant grouper, tiger shrimp, seaweed, sandfish, abalone, and natural food (algal paste feed and <i>Marphysa</i> sp.) will also continue.</p>	AQD	AQD*
<p>2. Healthy and Wholesome Aquaculture (2016-2020)</p> <p>The Program is critical in attaining significant improvements and sustaining aquaculture production in the face of many challenges posed by present and future ecological, economic, as well as climatic changes. The strategies invoked in this Program will concentrate on nutrition to promote healthy farmed aquatic animals; disease diagnosis, control, monitoring and surveillance of aquatic animals; and environmental integrity, certification, and food safety. The optimization and sustainability of aquaculture production shall be based on Best Management and Good Aquaculture Practices to ensure the least impact on the environment. There are two components under this program: (1) fish health, and (2) feed and nutrition.</p>	AQD	AQD*

<p>The <i>Fish Health</i> component aims to improve aquaculture production through innovations in fish health management in aquaculture. In 2019, the continuing study on tilapia lake virus (TiLV) will start its 1-year sampling and monitoring. The collected samples (water, soil, and animal) will undergo virus detection using PCR and confirmation using histopathology.</p> <p>Efficacy of different therapeutants against <i>Caligus</i> sp. will also continue with evaluation of the efficacy of other possible therapeutants such as hydrogen peroxide and herbal extract of onion at various concentrations, as a preventive treatment against sea lice in pompano.</p> <p>Following the experimental run during the wet season, the study on <i>Penaeus vannamei</i> using Biofloc system will do a run during the dry season for comparison.</p> <p>As for disease and pest detection in seaweeds, surveillance, monitoring of current and emergent diseases/pests in farms will continue. Formulation of proactive management protocols and tools for seaweed diseases will commence.</p> <p>Issues and gaps per commodity will also be addressed this year including testing solutions for emerging diseases (e.g. <i>Streptococcal</i> infection and vibriosis in marine fish, prevention and control of <i>Amyloodinium</i> infections). The program also aims to address the lack of good quality shrimp by using probiotics in hatchery and production through polyculture. Updating of manuals and publications is also a priority.</p> <p>For the <i>Feed and Nutrition</i> component, the objective is to find effective alternative protein sources to fish meal in dietary formulations and determine specific nutrients that enhance growth performances.</p> <p>The proposed projects and activities for 2019 under the Program will include demonstration of Phytoecdysteroids Crude Extract (PCE) from spinach for molting crabs, evaluation of green macroalgae <i>C. linum</i> as food source for farmed <i>P. monodon</i>, amino acid requirements of pompano <i>Trachinotus blochii</i>, and spray dried hemoglobin powder meal as alternative protein source in grouper diet.</p> <p>Drafting of hatchery operation manual following the demonstration of the viability of hatchery-bred <i>P. indicus</i> in semi-intensive culture in ponds using SEAFDEC formulated diet is also planned as proposed.</p>		
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<p>3. Adapting to Climate Change Impacts (2016-2020)</p> <p>The Program aims to identify the changes in the environment brought about by the changing climate that may affect the aquaculture sector. It also aims to prepare the sector for the possible effects of these changes, minimize and mitigate the adverse impacts of climate, and ensure the continued operation of all aquaculture production systems under the changing climatic conditions.</p> <p>In 2019, the activities under the Program include: (1) adoption and promotion of adaptive practices, such as: culture of fast growing species, use of larger fingerlings, use of recirculating aquaculture systems, IMTA, rice-fish culture, aquaponics, precision farming, etc.; (2) continue evaluation of potential alternative ingredients for fish feeds; (3) implementation of zoning, monitoring, early warning systems; and (4) promotion of seaweeds and mollusk farming, and also mangrove reforestation for carbon sequestration</p>	<p>AQD</p>	<p>AQD*</p>
<p>4. Maintaining Environmental Integrity through Responsible Aquaculture (2016-2020)</p> <p>The Program aims to develop environment-based aquaculture technology by integrating environmental factors in AQD research activities and to maintain environmental integrity by promoting responsible aquaculture practices.</p> <p>In 2019, research activities under this Program will include continuing studies on giant freshwater prawn culture in lake-based cages, sea-based grow-out culture of abalone in pipes, culture of polychaetes in raceways, and evaluation of IMTA culture system in pens with milkfish, seaweeds, and sea cucumbers. The studies under JTF 6 will continue on its last year in 2019, covering the topics on sea horse stock enhancement and aquasilviculture of tiger shrimps in brackishwater ponds under the Program “Maintaining Environmental Integrity through Responsible Aquaculture” (MEITRA).</p> <p>Meanwhile, the new research studies starting 2019, will include manipulative experiments to develop a strategic feeding technique for milkfish based on compensatory growth responses for cage culture applications, bio-secured production of soft-shell mangrove crabs in ponds, individual culture of oyster in pouches within brackishwater ponds and rivers, and enhanced</p>	<p>AQD</p>	<p>AQD*</p>

<p>production of sea cucumbers from hatchery to grow-out in sea ranch.</p> <p>The activities under the “Joint Mission for Accelerated Nationwide Technology Transfer Program for Aquaculture” (JMANTTP II) will continue in 2019. A collaborative project of AQD with the Bureau of Fisheries and Aquatic Resources (BFAR) in the Philippines, it aims to promote sustainable aquaculture technologies and facilitate the transfer of such technologies to stakeholders through training, demonstration and technical assistance.</p> <p>As part of the priority of MEITRA in 2019, linkages with the local government units and agencies would be strengthened to ensure the efficient enforcement of environmental laws and promotion of eco-friendly culture systems and methods through dissemination of information, education and communication materials to stakeholders.</p>		
<p>5. Meeting Social and Economic Challenges in Aquaculture (2016-2020)</p> <p>The Program generally aims to develop and implement social and economic strategies in aquaculture and resource management to secure food and income through stakeholder collaboration. In 2019, the planned activities under this Program will include the continuing study on anguillid eels with a survey which will provide basis for the improvement of nursery and grow-out technologies and the formulation of policies to support the industry.</p> <p>For projects under the Integrated Multi-Trophic Aquaculture (IMTA), a model estimation of the technical economic efficiency in small-holder milkfish mariculture in the Philippines will be conducted followed by an IMTA post-project assessment. This will also include the economic analysis update of various production systems (broodstock maintenance and larval production, fry and fingerling production, grow-out) including new culture species such as sandfish.</p> <p>A collaborative stock enhancement of <i>P. monodon</i> in New Washington Estuary will be conducted in partnership between AQD, Aklan State University, LGU and BFAR Region VI to enhance the role of aquaculture in securing food and fishing livelihoods.</p>	AQD	AQD*

<p>6. Priority and Special Projects (2016-2020)</p> <p>The Program is aimed at streamlining AQD's R&D programs to focus more on enhanced transfer of mature technologies for food security and poverty alleviation. All activities will be continued in 2019 including the sustained partnership between the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) and AQD. Included in the activities is the establishment of a feedmill plant for low-cost broodstock diets of commercially-viable fishes and crustaceans which will commence following the approval of the proposal. Another project under the BFAR-AQD partnership is the establishment of legislated multi-species hatcheries which will also continue in 2019.</p> <p>For training and information, the second wave of internship training for manpower development will be conducted, while researchers would be encouraged to publish helpful information materials for use of the stakeholders.</p>	AQD	AQD*
<p>7. Promotion on Strengthening of SEAFDEC Visibility and Enhancing Human Capacity Building (2019)</p> <p>Under the Program, fisheries information based on the roles and activities of SEAFDEC/TD would be imparted to the public through production and dissemination of materials, and participation in national and international exhibitions. In 2019, three issues of Advance Fisheries Technology would be produced, while information packages on responsible fisheries would also be developed and disseminated to promote awareness and understanding of fishers, stakeholders and the public. The Website would be enhanced and databases would be developed to support the projects implemented by TD. Furthermore, capacity building would be provided for SEAFDEC staff to develop their skills for enhancing information-related works. TD would also sustain the conduct of tailor-made training course(s) upon the request of Member Countries, non-Member Countries, and other organizations.</p>	TD	TD*
<p>8. Improvement of Fisheries Technology and Reduction of the Impact from Fishing (2019-2020)</p> <p>The Program comprises activities under three components, namely: 1) Promotion of appropriate technologies and practices of fishing and marine engineering to enhance sustainable marine fishery resources utilization; 2) Fisheries research on the impact</p>	TD	TD*

<p>of fishing on marine ecosystems; and 3) Development of database to support the fisheries management for Thailand.</p>		
<p>9. Collaborative Research between JIRCAS and SEAFDEC/MFRDMD (2019-2020)</p> <p>The Program aims to obtain understanding on coastal community requirements during monsoon season, which usually occur annually from November to February in the east coast of Peninsular Malaysia, and introduce alternative livelihoods to the coastal communities during the monsoon season.</p>	MFRDMD	JIRCAS & MFRDMD
<p>10. Fish Stock Assessment and Production Potential of Inland Fisheries (2017-2020)</p> <p>The purpose of this Project is to determine the amount of fish stocks, production potential, sustainable potential yield (MSY), and total catch that can be used as a basis for fisheries management in the Indonesian inland waters (Fisheries Management Area (FMA) number 439, 438, 431, 432, 435 and 436). Based on the analysis of the data obtained from each FMA, the development and management of fisheries and the conservation of fish resources in inland fisheries would be facilitated towards sustainability so that synergy and integration among the inland waters could be achieved.</p>	IFRDMD	Indonesia
<p>11. Center of Excellence in Science and Technology for Inland Fisheries Management (2018-2021)</p> <p>This Project is aimed at establishing a center of excellence in science and technology for inland fisheries management with national and international standards. In 2019, the activities that would be conducted, include: 1) Determination of fish stock and fish production from inland fisheries in Indonesia; 2) Scheming of fish passage design and principles to enhance the sustainability of inland fishery resources; and 3) Establishment of conservation areas based on results of fish stock assessment.</p>	IFRDMD	Indonesia

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

3) Other Programs

Program Title	Department	Funding Source
1. Implementing the Lower Mekong Fish Passage Initiative in Cambodia, Thailand, and Viet Nam (2018-2019) The objective of the Project is to build the capacity of the SEAFDEC and Lower Mekong nations to construct and maintain low head fish passes to restore fisheries connectivity at irrigation facilities, weirs, and road prisms. The expected outcomes include: 1) Appropriate site selection for demonstration of fish passage in Cambodia, Thailand and Viet Nam; 2) Demonstration fish passage construction in Cambodia, Thailand, and Viet Nam; and 3) Distribution of demonstration fish passage technical information. The project is undertaken mainly by the US Department of Interior (US-DOI), with engagement of TD in following-up with respect to the construction and communication with local contractors. The project would complete the construction of demonstration fish passages in 2019, one each in Cambodia, Thailand, and Viet Nam.	TD	US-DOI

In addition to the above projects and programs, there were also two (2) **pipeline projects** of which the proposals are prepared in consultation with respective donor agencies and the Member Countries. These projects would be implemented under the FCG/ASSP mechanism once funding could be secured.

Project Title	Lead Department	Potential Donors
1. Development of Stock Assessment Method and Strengthening of Resources Management Measures on Tropical Anguillid Eels in ASEAN Region	SEC	JAIF
2. Second Phase of Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management	MFRDMD	JAIF and other donors

COOPERATION WITH DONORS AND OTHER ORGANIZATIONS IN 2018

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 2018, twenty-four (24) projects were implemented by SEAFDEC under the FCG/ASSP Mechanism. The progress and achievements in the implementation of these projects were reported to the 21st Meeting of the FCG/ASSP organized on 8-9 November 2018, Langkawi, Malaysia

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 2018 SEAFDEC was represented in several regional events organized by the ASEAN, namely: the 8th Meeting of the ASEAN Shrimp Alliance (ASA) (21-22 March 2018, Bangkok, Thailand); the 14th Meeting of the ASEAN Working Group on the Convention on International Trade in Endangered Species on Wild Fauna and Flora (CITES) and Wildlife Enforcement (20-22 March 2018, Luang Prabang, Lao PDR); the 10th Meeting of the ASEAN Fisheries Consultative Forum (AFCF) (7-8 May 2018, Bangkok, Thailand); and the 26th Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGF) (9-12 May 2018, Bangkok, Thailand).

- **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Secretariat**

On 8 March 2018, SEAFDEC signed with the CITES Secretariat the Small-Scale Funding Agreement (SSFA) to co-operate in the implementation of the CITES provisions on sharks and rays through targeted support for data collection and training in the development of Non-Detriment Findings (NDF). The activities to be undertaken under this SSFA include: 1) Assistance to 4 information-poor Parties (envisioned: Myanmar, Vietnam, Cambodia, Philippines) on catch data collection for sharks and rays at the species level, to improve their capacity to make non-detriment findings for CITES-listed species in the medium-term; 2) Support to 3 Parties (envisioned: Indonesia, Malaysia, Thailand) where data is available for the development of national NDFs; and 3) Presentation of interim project results at a side event at CITES CoP18 (23 May - 3 June 2019). Implemented starting in 2018, this SSFA will be completed in September 2019.

Considering that SEAFDEC has been collaborating with the Member Countries for the conduct of several projects that address issues on the listing of commercially-exploited aquatic species into the CITES Appendices, the initial results from the eel project in 2018 were conveyed to CITES during the relevant events, namely: the CITES International Technical Workshop on Eels (*Anguilla* spp.) (18-20 April 2018, London, UK); and the Animal Committee Meeting of CITES (16-21 July 2018, Geneva, Switzerland). It is expected that the information and data presented during these events would support the development of common/coordinated positions among the ASEAN-SEAFDEC Member Countries for the forthcoming Conference of the Parties to CITES scheduled in May 2019.

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

Under the framework of the Memorandum of Understanding (MOU) for cooperation between SEAFDEC and the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF), which was signed in 2015, SEAFDEC continued to cooperate with the CTI-CFF in 2018 particularly by providing technical inputs to the events organized by the CTI-CFF that include: the CTI-CFF Public-Private Partnership (PPP) Preparation: Expert consultation Meeting on PPP Design and Arrangement (4-5 April 2018, Jakarta, Indonesia); the 2nd Threatened Species Technical Working Group (TWG) of CTI-CFF (24-26 April 2018, Quezon City, Philippines); Learning Exchange for Coral Triangle Member Countries to the USAID Oceans Partnership's Learning Site (Bitung, Indonesia) on the Application of CDT System for Fisheries and Seafood Products (25-28 June 2018 Manado-Bitung, Indonesia); Regional Convergence Meeting: Towards Establishing Transboundary Coordination Mechanisms for the Sulu-Sulawesi Seascape (2-6 July 2018, Philippines); and the 14th Senior Officials' Meeting (SOM-14) and 7th Ministerial Meetings of CTI-CFF, 12-16 November in Manila, Philippines.

- **China-ASEAN Center for Joint Research & Promotion of Marine Aquaculture Technology**

On 1 June 2018, a Memorandum of Understanding (MOUs) was signed between SEAFDEC Aquaculture Department (AQD) and China-ASEAN Center for Joint Research and Promotion of Marine Aquaculture Technology. The purpose of this MOU is to establish a framework for the effective and mutually beneficial crustaceans and fishes cooperation. This MOU shall remain in effect for an initial period of two (2) years.

- **Ocean University of China (OUC)**

On 1 June 2018, Memorandum of Understanding (MOUs) were signed to establish AQD's international link with two institutions under the Ocean University of China. The first MOU was with Shangdong International Science and Technology Demonstration Cooperation Base for Marine Aquaculture and Fishery College of Marine Life Sciences, with the purpose of establishing a framework for the effective and mutually beneficial marine aquaculture and fishery cooperation; while the second MOU was with Seaweed Base for International Science and Technology Cooperation for the establishment of a framework for the effective and mutually beneficial seaweed cooperation. Both MOUs shall remain in effect for the period of five (5) years.

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

SEAFDEC continued to be involved in regional and international events organized by FAO in 2018, namely: the FIRMS- Global Record of Stocks and Fisheries (GRSF) Technical Working Group Meeting (7-9 February 2018, Rome, Italy); FAO Panel on Catch Documentation Scheme during the “2018 Seafood Expo North America” (11-13 March 2018, Boston, USA); Regional Technical Seminar on Joining Forces in the Fisheries Sector: Promoting Safety, Decent Work and the Fight against IUU Fishing (21-22 March 2018, Manila, Philippines); the 34th FAO Regional Conference for Asia and the Pacific (9-13 April 2018, Nadi, Fiji); the 7th APFIC Regional Consultative Forum Meeting (RCFM): Sustainable Development for Resilient Blue Growth of Fisheries and Aquaculture (7-9 May 2018, Cebu, Philippines); the 35th Session of Asia-Pacific Fishery Commission (APFIC) (11-13 May 2018, Cebu, Philippines); 2018 Aquatic Sciences and Fisheries Abstract (ASFA) Advisory Board Meeting (11-15 June 2018, Oostende, Belgium); PSMA Part 6 Working Group on Requirements of Developing States (5-6 July 2018, Rome, Italy); the 7th Meeting of Regional Fishery Body Secretariats Network (RSN) (7 and 13 July 2018 Rome, Italy); the 33rd Session of the Committee on Fisheries (COFI) (9-13 July 2018, Rome, Italy); Global Conference on Tenure and User Rights 2018: Achieving Sustainable Development Goals by 2030 (User Rights 2018) (10-14 September 2018, Yeosu, Republic of Korea); 2018 Asia and the Pacific Regional Overview of Food Security and Nutrition: Accelerating Progress Towards the SDGs (2 November 2018, Bangkok, Thailand); and the Inception Workshop of the Regional Technical Cooperation Project: Support Countries to Address Illegal, Unreported and Unregulated (IUU) Fishing (TCP/PRAS/3621) (13-15 November 2018, Bangkok, Thailand).

Furthermore under the existing Partnership Agreement between SEAFDEC and the FAO/ Aquatic Sciences and Fisheries Abstracts (ASFA) established since 2013 for SEAFDEC to provide inputs to ASFA, on 7 September 2018, SEAFDEC/AQD signed an a Letter of Understanding (LOA) with FAO for the “Digitisation, Open Access Deposition and the Provision of URL’s to Existing ASFA Records of the Conference Proceedings Published by SEAFDEC Secretariat, Training Department (TD), Marine Fisheries Research Department (MFRD), Marine Fishery Resources Development and Management Department (MFRDMD), and Aquaculture Department (AQD).” Under this LOA, AQD will be producing full-text PDF files of documents published by SEAFDEC for deposition in open-access repository, preparation of ASFA records for inclusion in the ASFA database, and providing links for digitized documents with existing ASFA records.

As part of the collaboration with FAO, SEAFDEC/IFRDMD also organized the “Workshop on Regional Awareness Raising in Asia on Prospective Species Proposals to CITES-CoP18 and Preparation of Fisheries Related Information to Support the Review of Species Proposals Against CITES Listing Criteria” on 24-25 October 2018 in Palembang, Indonesia. During the Workshop, FAO provided information on the implications of such proposals on the sustainability of the fisheries in the region; while the participating countries prepared and provided 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 during the forthcoming Conference of the Parties to CITES in 2019.

- **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.

- **INFOFISH**

SEAFDEC has been requested by the Member Countries during the past few years to exert efforts to update the synthesis on development of international fish trade, including providing links in SEAFDEC website to information, *e.g.* price, international fish trade profile of the Member Countries. Considering that the subject is also under the mandate of INFOFISH, collaboration between SEAFDEC and INFOFISH has therefore been pursued. In 2018, SEAFDEC officials attended in the 15th INFOFISH World Tuna Trade Conference and Exhibition (28-30 May 2018, Bangkok, Thailand); 31st INFOFISH Technical and Advisory Board (TAB) Meeting (17-19 July 2018, Kuala Lumpur, Malaysia); and 33rd INFOFISH Governing Council Meeting (17-20 December 2018, Langkawi, Malaysia). The close collaboration between INFOFISH and SEAFDEC is expected to be further strengthened in the future.

- **Islamic Development Bank (IDB)**

Under the Technical Assistance (TA) Agreement by IDB and SEAFDEC in 2016, SEAFDEC/MFRDMD 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. The original period for this project was from 2016 to 2017 however, the project was extended until 2018. The “Terminal Regional Technical Consultation on Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management” was organized on 20-22 March 2018 to conclude the overall activities and report on the achievement of the project.

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

With funding support from the Japan-ASEAN Integration Fund (JAIF), the SEAFDEC Secretariat in collaboration with IFRDMD and AQD implemented since 2017 the project “Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia,” which was completed in 2018. SEAFDEC/AQD in collaboration with the Department of Fisheries of Thailand also conducted the “ASEAN Regional Technical Consultation on Aquatic Emergency Preparedness and Response Systems for Effective Management of Transboundary Disease Outbreaks in Southeast Asia” on 20-22 August 2018 in Bangkok, Thailand with funding support from JAIF.

In addition, the proposal for the project “Strengthening the Effective Management Scheme with GIS (Geographic Information System) and RS (Remote Sensing) Technology for Inland Fisheries and Aquaculture at AMSs” was approved by JAIF for implementation starting January 2019. Meanwhile, the proposed projects “Development of Stock Assessment Method and Strengthening of Resources Management Measures on Tropical Anguillid Eels in ASEAN Region” and “Second Phase of Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management” are still under discussion and negotiation between SEAFDEC and JAIF.

- **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 a decade of the vessel’s service, discussion was made in 2015 for the possibility of restoring the functions of the M.V. SEAFDEC 2 with funding support from the Japan International Cooperation Agency (JICA). Thus, SEAFDEC and JICA agreed in 2016 on the scope of work and the schedule for restoration of the M.V. SEAFDEC 2.

In 2018, SEAFDEC and JICA pursued the “Follow-up Cooperation for the Project for Construction of a Fisheries Research and Training Vessel” with the aim of restoring the function of the M.V. SEAFDEC 2. The activities included procurement, and restoration and installation works of the necessary equipment, which include items on deck machinery, engine room, Immarsat equipments, and fishing electronics and scientific equipment.

- **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 the 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. In 2018, the staff of MRC also attended the several events organized by SEAFDEC, *e.g.* the “Training Course on Introduction of Simple Stock Assessment Methods in Inland Fisheries” conducted on 19-20 September 2018 in Samut Prakan, Thailand; and the “Experts Consultation Workshop on Guidance to Monitor and Evaluation of Gender Equity and Social Well-being in Fisheries Communities” on 8-10 August 2018 in Bangkok, Thailand.

- **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 the 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 by participating during the 29th Meeting of NACA Governing Council on 26-28 June 2018 in Maldives.

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

Since 2016, SEAFDEC has served as implementation 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. In 2018, SEAFDEC conducted the “Regional Scientific and Technical Committee Meeting of the SEAFDEC/UNEP/GEF Project on Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand” on 11-13 September 2018 in Trat Province, Thailand. In addition, the first Project Steering Committee (PSC) Meeting of the Project was also organized on 4-5 December 2018 in Bangkok, Thailand.

- **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 USAID Oceans which 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 an Ecosystem Approach to Fisheries Management (EAFM) and CDT; and 4) engage the private sector to ensure sustainability, while advancing regional fisheries governance. The project has two learning sites: one in General Santos City, Philippines and another in Bitung, Indonesia; and two expansion sites in Thailand and Malaysia.

TD with support from the USAID and in collaboration with the US Department of the Interior (DOI) and the Mekong River Commission (MRC) also organized the “Fish Passage Engineering Design, Construction, Ecology, and Monitoring Workshop” on 13-16 November 2018 Samut Prakan, Thailand. The Workshop provided technical engineering concepts needed for selection of appropriate fish passage designs for specific sites, designing of fish passes to maximize fish passage success, and construction of cost-effective structures with long life span. Information was also provided on developing the fish passage criteria, identifying the target species, understanding river hydrology, evaluating fish swimming abilities, and designing of the monitoring programs.

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

In 2017, SEAFDEC signed a Memorandum of Understanding (MOU) with the United States Department of Interior (US-DOI) for the conduct of the activity “Advancing the Development and Implementation of a Fisheries Catch Documentation and Traceability System in Southeast Asia” to supplement those carried out by the USAID Oceans.

On 31 July 2018, the collaborative activity between SEAFDEC and US-DOI was expanded with the signing of the new Annex to the MOU on “Implementing the Lower Mekong Fish Passage Initiative in Cambodia, Thailand, and Vietnam.” This particular Annex aims to build

the capacity within SEAFDEC and Lower Mekong nations to construct and maintain low head fish passes to restore fisheries connectivity at irrigation facilities, weirs, and road prisms. The specific objectives of this Annex are to: 1) Coordinate field fish passage barrier inventories in Cambodia, Thailand, and Vietnam; 2) Design and construct one demonstration fish pass in Cambodia, one demonstration fish pass in Thailand, and one demonstration fish pass in Viet Nam; and 3) Sustain Project administration and coordination. The implementation of this Annex would run from the date of signing until 30 September 2019.

- **United States National Oceanic and Atmospheric Administration (NOAA)**

The 2018, the National Oceanic and Atmospheric Administration (NOAA) extended support to several activities undertaken by SEAFDEC, particularly in the capacity building of AMSS on Port State Measures and updating the training modules for the Ecosystem Approach to Fisheries Management (EAFM).

On PSM, an expert from NOAA served as the resource person during the “Regional Training on Port State Measures Implementation in Southeast Asia” organized by TD on 20-23 February 2018 in Bangkok, Thailand.” On EAFM training modules, TD in collaboration with NOAA Fisheries and the National Ocean Service also organized the “Workshop on Revision of the E-EAFM Toolkit and Development of the EAFM Application and Implementation Training Package” on 14-16 November 2018 where the need to update the training materials on Essential EAFM which had been developed since 2012, was discussed.

Collaboration with National Agencies of SEAFDEC Member Countries

- **Department of Fisheries, Thailand – Aquatic Animal Health Research and Development Division (DOF-AAHRDD)**

In August 2018, AQD signed a Letter of Agreement (LOA) with the Department of Fisheries, Thailand – Aquatic Animal Health Research and Development Division (AAHRDD) to collaborate in the efforts of conducting the “ASEAN Regional Technical Consultation on Aquatic Emergency Preparedness and Response Systems for Effective Management of Transboundary Disease Outbreaks in Southeast Asia” with funding support from the Japan-ASEAN Integration Fund (JAIF). Under this LOA, both organizations will share the responsibility for fund management, reporting and implementation.

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

The Memorandum of Understanding (MOU) for Scientific and 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 the development of scientific and technical cooperation in various fields of mutual interest; exchange of information and expertise; and conduct of detailed discussions between SEAFDEC and FRA on matters practical to both organizations. In addition to *Dr. Kenji Taki* who has served as Deputy Chief of MFRDMD since April 2017; FRA also dispatched *Dr. Takuro Shibuno* to serve as Deputy Chief of IFRDMD starting in January 2018, and *Dr. Kohichiro Mori* as Deputy Chief of AQD starting April 2018. FRA also extended the services of its experts to SEAFDEC to support the conduct of its activities, *e.g. Dr. Tsutomu (Tom) Nishida* on stock assessment of neritic tunas and other species in Southeast Asia.

- **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 facilitates the dispatch of trainees from the Southeast Asian region to the Gifu Prefecture Inland Fisheries Training Center in Japan. Under the framework of this MOU, Gifu Prefecture supported in 2018 the participation of eight officials, comprising one each from the Southeast Asian countries, namely: Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines and Thailand; and one staff from SEAFDEC/IFRDMD to participate in the Gifu Prefectural Inland Fisheries Training Program from 28 August to 6 September 2018 at Gifu Prefectural Research Institute for Fisheries and Aquatic Environments and Inland Fisheries Training Center in Gifu, Japan.

- **Hokkaido University, Japan**

In 2018, Hokkaido University of Japan continued to extend support to SEAFDEC and the Member Countries with particular focus on fish stock assessment. Specifically, experts from Hokkaido University also supported MFRDMD in 2018 during the conduct of two surveys and data collection, and analysis of the species composition of catch at the purse seine fisheries landing centers along the east coast of Peninsular Malaysia.

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

Under the 5-year Arrangement for Academic and Educational Cooperation between the Tokyo University of Marine Science and Technology (TUMSAT) and SEAFDEC which was signed in 2015, collaboration between TUMSAT and SEAFDEC was pursued in 2018. A fishery oceanographer from TD joined the “21st Kaiyodai Antarctic Research Expedition (KARE21)” conducted by the Tokyo University of Marine Science and Technology (TUMSAT) of Japan, onboard its training vessel the “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. In 2018, SEAFDEC was invited to participate in the International Collaborative Symposium on Marine Science and Technology (26 November 2018, Bali, Indonesia) organized by TUMSAT. Furthermore, TUMSAT also extended the services of its Researcher *Dr. Toshihide Kitakado* as lecturer during the “Training Course on Introduction of Simple Stock Assessment Methods in Inland Fisheries” organized by TD on 19-20 September 2018 at the TD premises in Samut Prakan, Thailand, and intended for the staff of SEAFDEC and the AMSs working on stock assessment.

- **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 2018, 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 since 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. In 2018, SEAFDEC continued to avail of the services of concerned FMO staff for the promotion of the eACDS, particularly during the pilot testing for implementation of the eACDS in Brunei Darussalam.

- **Burapha University, Thailand**

On 27 October 2018, SEAFDEC signed a Memorandum of Understanding (MOU) between Burapha University (BUU), Thailand and SEAFDEC for cooperation on educational and research activities. The areas of cooperation under this MOU would include: a) exchange of research materials, publications and information; b) development and operation of joint academic programs; c) support for distance learning courses; d) organization of joint research programs; e) exchange of students/staffs; f) development of common curricula in areas of mutual interest; and g) co-operation in other academic and research activities. This MOU is meant to serve as general collaborative frameworks without legal and financial obligations of both Partners. However, in undertaking particular activities, specific activity agreements would be formalized based on the mutual agreement of the Partners. The MOU would valid for a period of five (5) years from the date of signing.

- **Southern Vocational Institute of Agriculture, Thailand**

On 24 October 2018, SEAFDEC signed an MOU with the Southern Vocational Institute of Agriculture, under the Office of Vocational Education Commission of Thailand, for the development of manpower for training. The cooperation has the objectives of building human capacity through the conduct of training, exchange of staff, and participation of staff to workshops, seminars and discussions on specific subjects; conducting collaborative research; developing and exchanging information technologies, including the development of network of information; enhancing multi-lateral cooperation among public-, private-sector and inter-governmental organizations; and promoting the development of fishing technologies. The MOU would be valid for the period of 5 years starting from the date of signing.

ENHANCING SEAFDEC VISIBILITY IN 2018

Since its establishment, SEAFDEC has been implementing fisheries-related programs and 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 with the objective of enhancing the effectiveness of the implementation, monitoring, and reporting of the progress of SEAFDEC information-related activities.

In 2018, the progress and achievements made by SEAFDEC in the implementation of information activities were monitored and discussed during the 19th Meeting of the Information Staff Program (ISP) on 9 to 11 October 2018 in Chonburi, Thailand. The progress of the activities corresponding to the five Information Strategies, is shown as follows:

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

- Technical/scientific materials: 49 title/issues: 28,134 copies produced, 19,041 copies distributed, and 3,324 e-copy distributed
- Technical/scientific articles: 48 titles: 17 titles published in SEAFDEC publications and 31 titles published in non-SEAFDEC publications
- Inquiries for information through the SEAFDEC libraries recorded and replied: 6,167 queries recorded, 813 materials sold, and 1,567 citations

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

- Promotional materials: 31 titles/issues: 36,519 copies produced, 27,291 copies distributed, and 11,361 e-copies distributed
- Promotional souvenirs: 45,074 items produced, and 31,233 items distributed
- Promotional videos: 27 titles, 33 copies produced, 10 copies distributed, and 5,985 online views
- SEAFDEC websites established: SEAFDEC Departmental websites received a total of 109,778 unique visitors, 10,655 links from other websites
- Project websites: 2,169 unique visitors, and 492 links from other websites
- Social media administered by SEAFDEC: 24,552 unique visitors, and 195,792 likes
- Participation in exhibitions and related events: joined nine (9) exhibitions with 113,741 visitors recorded at SEAFDEC exhibition booths and displays
- Official press statements released: forty-five (45) press statements released, and recorded 134 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 Department Libraries continued to provide library services

- Additional acquisitions of SEAFDEC libraries: total of 485 issues of newsletters/serial publications, 473 titles of technical publications and 27 items of audio-visual materials were acquired
- Cooperation and exchange of materials: sustained cooperation with 479 network libraries within and outside the region
- Dissemination of technical and promotional materials: 38 titles (with 5,562 copies) of technical materials, and 30 titles (with 21,095 copies) of promotional materials disseminated to target groups
- Accessibility of information materials: 2,804 downloadable materials, 2,283,644 downloads during reporting year, and 1 databases made accessible in SEAFDEC websites
- The Institutional Repository: 455,391 accesses, 340,738 unique visitors; 1,241 titles uploaded during reporting year, 4,731 accumulated titles, and 2,302,074 accumulated downloads
- Usage of e-mail systems (including e-groups) to facilitate communications among SEAFDEC staff and with other concerned personalities had been enhanced
- Direct visitors to SEAFDEC Secretariat and Departments: recorded a total of 26,381 visitors
- Participation of SEAFDEC officials to events organized by other organizations: 428 SEAFDEC officials participated in 253 events: 111 officials in events at regional/international levels, and 142 at national/local levels
- Number of presentations made by SEAFDEC Staff at non-SEAFDEC events: 74 oral presentations, and 3 poster presentations in events at regional/international levels; and 13 oral presentations, and 1 poster presentation in events at national/local levels
- SEAFDEC events organized:
 - o International/regional meetings, seminars, workshops: 39 meetings with 1,483 participants
 - o National/local meetings, seminars, workshops, consultations: 26 meetings with 907 participants
 - o International/regional training courses: 11 courses with 156 trainees
 - o National, on-site training courses: 26 courses with 438 trainees
 - o Study tours: 2 programs with 23 trainees
 - o Internships: 9 groups with 39 interns
 - o On-the-job training: 6 colleges participated with a total of 406 students
 - o Internal meetings: 14 meetings with 1,493 participants
- Participation of officials from Member Countries in events organized by SEAFDEC:
 - o International/regional meetings, seminars, workshops (746 participants)
 - o National/local meetings, seminars, workshops, consultations (706 participants)
 - o International/regional training courses (123 trainees)
 - o National on-site training courses (443 trainees)
 - o Study tours (24 trainees)
 - o Internships (39 persons)
 - o On-the-Job training (406 students)
- Network and cooperation mechanisms established (now with 63 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 2018: US\$ 5,587,214 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.)
- Nineteenth 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 9-11 October 2018 in Thailand)

Table 1. Participation of Member Countries in SEAFDEC Events in 2018

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	102	69	25	48	79	52	35	17	233	63
SEAFDEC national/local meetings, seminars, workshops, consultations	0	147	25	0	23	33	138	245	0	42	53
International/regional training courses	3	9	11	0	5	13	10	38	12	14	8
National, on-site training courses (course/trainees)	0	65	3	0	0	9	59	205	0	38	64
Study tours (no. of program/trainees)	0	2	3	0	0	0	0	14	0	5	0
Internships (group/persons)	0	0	0	1	0	0	0	23	0	15	0
On-the-job training (college/students)	0	0	0	5	0	0	0	379	0	21	1
SEAFDEC internal events	0	0	0	5	0	0	0	20	0	43	0
TOTAL	26	325	111	36	76	134	259	595	29	411	189

SEAFDEC REVENUES AND EXPENDITURES IN 2018

Southeast Asian Fisheries Development Center

Un-Audited Abridged Consolidated Financial Statements-2018 (in US\$)

	2018 (Un-audited)	2017 (Audited)
REVENUES		
Contributions from:		
Member governments	10,210,335	9,600,319
Other sources	2,342,345	1,511,499
Total Revenues	<u>12,552,680</u>	<u>11,111,818</u>
EXPENDITURES		
Operating and Capital Expenditures		
Research	3,400,654	3,060,955
Training	1,082,984	1,187,743
Information	626,950	598,738
Collaborative	128,348	160,716
Others	632,347	504,695
Administrative	5,092,093	4,941,639
Total Expenditures	<u>10,963,376</u>	<u>10,454,486</u>
SURPLUS (DEFICIT), For the year	1,589,304	657,332
FUND BALANCE, Beginning of year	10,579,180 ^{1/}	10,002,772
FUND ADJUSTMENT	(11,433)	3,501
FUND BALANCE, End of year	<u>12,157,051</u>	<u>10,663,605</u> ^{1/}
REPRESENTED BY:		
Cash and cash equivalents	13,047,451	11,518,615
Other receivables and Advances	287,431	286,808
Supplies Inventory	23,449	24,649
Fuel for vessels	156,244	222,266
Prepayments	34,449	31,838
Total Current assets	<u>13,549,024</u>	<u>12,084,176</u>
Reserved budget for vessel periodic maintenance	238,680	169,686
Termination indemnity fund	2,388,245	2,333,761
Long-term investments and Other noncurrent assets	524,293	537,861
Total Assets	<u>16,700,242</u>	<u>15,125,484</u>
Less: Liabilities		
Accrued payable	546,953	886,439
Contribution received in advance	1,352,868	982,920
Fund held in trust	255,125	258,759
Provision for termination indemnity	2,388,245	2,333,761
Total Liabilities	<u>4,543,191</u>	<u>4,461,879</u>
NET ASSETS	<u>12,157,051</u>	<u>10,663,605</u>

Remark: ^{1/} Difference of US\$ 84,425 is a result of change of rate in US\$ transaction.

Un-audited contribution received by SEAFDEC from Member Countries and other sources of funds for the year 2018 (In US\$)

Sources	Secretariat	TD	MFRD	AQD	MFRDMD	IFRDMD	Total	
							In US\$	%
Brunei Darussalam	7,000						7,000	0.06
Cambodia	12,000						12,000	0.10
Indonesia	52,000					989,459	1,041,459	8.30
Japan	280,000						280,000	2.23
Lao PDR	6,500						6,500	0.05
Malaysia	21,500				800,868		822,368	6.55
Myanmar	22,500						22,500	0.18
Philippines	25,000			4,754,660			4,779,660	38.07
Singapore	13,500						13,500	0.11
Thailand	33,000	3,166,348					3,199,348	25.48
Viet Nam	26,000						26,000	0.21
Sub-total	499,000	3,166,348	0	4,754,660	800,868	989,459	10,210,335	81.34
Other Sources ^{2/}	-2,334	1,617,427		727,252			2,342,345	18.66
Total	496,666	4,783,775	0	5,481,912	800,868	989,459	12,552,680	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 2018 (In US\$)

Sources	Amount in US\$ ^{3/}
UNEP/GEF	1,292,500
Japanese Trust Fund (excluded: Japan-MRC=US\$280,000)	1,550,357
Sweden	742,430
Japan-ASEAN Integration Fund (JAIF) for GIS and RS Technology	195,972
Total	3,781,259

Remark:

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



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