SEAFDEC Annual Report 2019

Southeast Asian Fisheries Development Center

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Preparation and Distribution of this Document

This SEAFDEC Annual Report 2019 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 2019 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 2019 had been categorized into: 1) Programs under the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) (23 projects); Departmental Programs (12 programs); and Other Programs (1 program). The programs were aligned with the "SEAFDEC Strategies Towards 2030" adopted by the SEAFDEC Council in 2017, comprising six Strategies, namely: 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 2019, 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 development of fisheries, specifically their expertise and relevant resources that were tapped for the programs and activities of mutual interest. 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; while efforts of the Departments in the implementation of the Information Strategies were sustained, especially the compilation of outputs from their programs and projects, and disseminating these to target audience. Furthermore, as the SEAFDEC Council adopted the SEAFDEC Gender Strategy in 2019, progress in the implementation of the Gender Strategy by the SEAFDEC Departments was also monitored and summarized in this Annual Report.

This SEAFDEC Annual Report 2019 could therefore be used as reference for obtaining 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. Furthermore, the issues and concerns as well as gaps and limitations could be used as take off points for which fisheries management in the whole Southeast Asian region could be improved.

MESSAGE FROM THE CHAIRPERSON OF SEAFDEC COUNCIL

The year 2019 marked another significant year for SEAFDEC, especially in terms of the number of prominent outputs generated from its programs of activities. The support extended by SEAFDEC to the ASEAN Member States (AMSs) toward combating IUU fishing has always been highly appreciated as this has led to significant achievements. In 2019, the outputs and outcomes from several works of SEAFDEC on sustainable fisheries development have become more concrete with the adoption of tools such as the Regional Fishing Vessels Record and the ASEAN Catch Documentation Scheme, as well as on strengthening of cooperation among the AMSs for the adoption of Port State Measures, among others. As these initiatives have widely complemented the on-going national tasks of the AMSs in combating IUU fishing, we would therefore encourage SEAFDEC to continue such momentum in the future. In 2019, we also saw the adoption by the ASEAN Ministers on Agriculture and Forestry, of regional guidelines produced by SEAFDEC, i.e. the "Regional Guidelines on Cold Chain Management for Seafood" and the "Regional Technical Guidelines on Early Warning System for Aquatic Animal Health Emergencies," which are crucial in ensuring the quality of fish and fishery products from our region being traded not only in domestic but also in the international markets, and in sustaining the region's aquaculture operations by making sure that these are not impeded by the spread of emerging aquatic diseases. We also noted the development of the "Regional Action Plan for Management of Transboundary Species: Indo-Pacific Mackerel in the Gulf of Thailand Sub-region," which marked the significant progress in strengthening the sub-regional management of transboundary aquatic species. With the development of these policy frameworks and together with other technical works, SEAFDEC has certainly helped the AMSs in making further their efforts towards the sustainable development of fisheries. The development of the "SEAFDEC Gender Strategy" that would serve as an overarching framework to ensure that gender equity is given due consideration in the operations and implementation of SEAFDEC programs and activities, is noteworthy. The other task given to SEAFDEC to review and revise the Resolution and Plan of Action on Sustainable Fisheries for Food Security Toward 2020 to make sure that the provisions remain applicable and valid beyond 2020, has been undergoing good progress, and we look forward to joining hands among the ASEAN-SEAFDEC Member Countries to adopt this document in the very near future.

The efforts of SEAFDEC to strengthen its cooperation and partnership with other international/ regional organizations and donor agencies, is also very much appreciated. We are aware that during the course of implementation of several programs of SEAFDEC, especially those that had been completed in 2019, collaboration had always been pursued with other organizations. We therefore look forward to having enhanced cooperation in the future to strengthen the capacity of SEAFDEC in fulfilling its role in the sustainable development of fisheries in Southeast Asian region.

Therefore, on the occasion of the publication of this Annual Report 2019 and on behalf of the SEAFDEC Council of Directors, we would like to congratulate SEAFDEC for its works and achievements, and we commend its efforts in supporting the Member Countries for the sustainable development of the fisheries sector. With this, we also confirm the commitment of the Member Countries to continue supporting SEAFDEC in its programs and projects in the years to come.

Mr. Nilanto Perbowo
Secretary General
Ministry of Marine Affairs and Fisheries of Indonesia

MESSAGE FROM THE SEAFDEC SECRETARY-GENERAL

2019 has been another significant year for SEAFDEC, as many projects undertaken for nearly a decade have come to fruition. A number of SEAFDEC projects implemented since 2013 including those supported by the Japanese Trust Fund, and the SEAFDEC-Sweden Project have been successfully completed in 2019. During such period, SEAFDEC carried out several activities such as research and development, capacity building, information generation and dissemination, and development of regional policy frameworks, and SEAFDEC had endeavored to ensure that these activities not only successfully address the priorities and needs of the Member Countries but also enhance the contribution of fisheries to food security and poverty alleviation in the region during the decades to come.

On the occasion therefore of the production of the SEAFDEC Annual Report of 2019, I would like to express our sincere appreciation to all those who have provided their support to our programs and activities that allowed us to achieve our goals. First of all, we wish to thank the SEAFDEC Member Countries and collaborating partners for their all-out and continued support to our activities and projects during the past years and to the SEAFDEC Council of Directors for extending their guidance that properly directed our operations toward attaining our goals. I also join hands with the Member Countries in acknowledging the support of the Government of Japan, not only in providing project funding but also dispatching several experts to share their knowledge and experience with local counterparts during the project operations. The Government of Sweden, as another prominent supporter of SEAFDEC also deserves our gratitude, especially that it has paved the way for the successful implementation of several regional and sub-regional initiatives, particularly the establishment of sub-regional mechanism for management of transboundary species and addressing IUU fishing. We also thank our other partners, particularly the ASEAN and FAO, among others that SEAFDEC had worked closely with, by ensuring that the results of our projects are beneficial to the ASEAN communities, and correspond to and comply with international instruments and requirements.

Although we might have addressed a wide range of issues and concerns through the projects we implemented throughout the past years, we also recognize that there are still many more challenges that loom ahead of us. These could emanate not only from within the fisheries but also from the other sectors, and could either create impacts on or are impacted by our fisheries sector. Specifically, while we trod the path towards early 2020, the Corona Virus-2019 emerged contributing a massive challenge not only to the fisheries but also to the other sectors of the society, and not only within the Southeast Asian region but also beyond. It is therefore becoming necessary for all of us, SEAFDEC and the Member Countries, to take proactive responses to understand the possible impacts of such scenarios and explore the ways and means of mitigating the impacts of this virus on the lives of peoples engaged in the fisheries sector. Closer cooperation among the countries

in this region and with partners, as well as between the fisheries and other sectors will therefore become more and more necessary in the near future.

At this juncture, please allow us to assure our Member Countries and the stakeholders once again that SEAFDEC would continue to render our best efforts for the benefit of the region, and address the priority issues on sustainable development and management of fisheries for the good of all.

Ms. Malinee Smithrithee
Secretary-General

LIST OF ACRONYMS

ACDS	ASEAN Catch Documentation Scheme
ACIAR	Australian Centre for International Agricultural Research
AFCF	ASEAN Fisheries Consultative Forum
AMAF	ASEAN Ministers on Agriculture and Forestry
AMSs	ASEAN Member States
AQD	SEAFDEC Aquaculture Department
APFIC	Asia-Pacific Fisheries Commission
ASEAN	Association of Southeast Asian Nations
ASSP	ASEAN-SEAFDEC Strategic Partnership
ASWGFi	ASEAN Sectoral Working Group on Fisheries
CBRE	Community-based Resource Enhancement
CBRM	Community-based Resources Management
CDT	Catch Documentation and Traceability
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CPUE	Catch Per Unit Effort
CTI-CFF	Coral Triangle Initiative on Coral Reefs Fisheries and Food Security
DA-BFAR	Bureau of Fisheries and Aquatic Resources, Department of Agriculture
DOF	Department of Fisheries
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
IFRDMD	SEAFDEC Inland Fishery Resources Development and Management Department
ILO	International Labour Organization
IUU Fishing	Illegal, Unreported and Unregulated Fishing
JAIF	Japan-ASEAN Integration Fund
JICA	Japan International Cooperation Agency
JIRCAS	Japan International Center for Agricultural Sciences
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
MMAF	Ministry of Marine Affairs and Fisheries
MSY	Maximum Sustainable Yield

NFRDI	National Fisheries Research and Development Institute, Philippines
NOAA	U.S. National Oceanic and Atmospheric Administration
PSM	Port State Measures
PSMA	Port State Measures Agreement
RS	Remote Sensing
RFMOs	Regional Fisheries Management Organizations
RFPN	Regional Fisheries Policy Network
RFVR	Regional Fishing Vessels Record for Vessels 24 m in Length and Over
RPOA	Regional Plan of Action
SDGs	Sustainable Development Goals
SFA	Singapore Food Agency
SEAFDEC	Southeast Asian Fisheries Development Center
SGFP	SEAFDEC Gender Focal Person
SOM-AMAF	Senior Officials Meeting of the ASEAN Ministers on Agriculture and Forestry
SWG	Scientific Working Group
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TD	SEAFDEC Training Department
TWG	Technical Working Group
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

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 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 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.

SEAFDEC/TD

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. However, with the formation of a new statutory board Singapore Food Agency (SFA) on 1 April 2019, the SFA continued to uphold Singapore's commitment to implement the MFRD programmes.

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 2019

Chairpersons of the SEAFDEC Council

H.E. Eng Cheasan *(until 18 March 2019)*
Mr. Nilanto Perbowo *(since 18 March 2019)*

SEAFDEC Council and Alternate Council Directors

Brunei Darussalam

Council Director:	**Ms. Mariani Haji Sabtu** *(until 25 December 2019)* Director, Department of Fisheries **Ms. Noraini Haji Anggas** *(since 26 December 2019)* Acting Director of Fisheries, Department of Fisheries
Alternate Council Director:	**Ms. Noraini Haji Anggas** *(until 25 December 2019)* Acting Deputy Director of Fisheries, Department of Fisheries **Ms. Wanidawati Tamat** *(since 26 December 2019)* Acting Deputy Director of Fisheries, Department of Fisheries

Cambodia

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

Indonesia

Council Director:	**Mr. Rifky Effendi Hardijanto** *(until 16 January 2019)* Secretary General, Ministry of Marine Affairs and Fisheries **Mr. Nilanto Perbowo** *(since 17 January 2019)* Secretary General, Ministry of Marine Affairs and Fisheries
Alternate Council Director:	**Prof. Sjarief Widjaja** *(since 17 January 2019)* Research and Human Resources, 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** *(until 15 October 2019)* Director, First Country Assistance Planning Division, International Cooperation Bureau, Ministry of Foreign Affairs **Mr. Shige Watanabe** *(since 16 October 2019)* Director, First Country Assistance Planning Division, International Cooperation Bureau, Ministry of Foreign Affairs

Lao PDR

Council Director:	**Dr. Somphanh Chanphengxay** *(until 23 September 2019)* Director-General, Department of Livestock and Fisheries **Mrs. Vilayphone Vorraphim** *(since 24 September 2019)* 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** *(until 6 February 2019)* Deputy Director-General (Development), Department of Fisheries Malaysia **Dato' Dr. Bah Piyan Tan** *(since 7 February 2019)* Deputy Director-General (Management), Department of Fisheries Malaysia

Myanmar

Council Director:	**Mr. Khin Maung Maw** Director-General, Department of Fisheries
Alternate Council Director:	**Mr. Myint Zin Htoo** Deputy Director-General, 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** Director-General of Food Administration, and Deputy Chief Executive Officer, Singapore Food Agency

Alternate Council Director:	**Mr. Lim Huan Sein** Director of Aquaculture Department, Singapore Food Agency

Thailand

Council Director:	**Dr. Adisorn Promthep** *(until September 2019)* Director-General, Department of Fisheries **Mr. Mesak Pakdeekong** *(since October 2019)* Director-General, Department of Fisheries
Alternate Council Director:	**Mr. Bunchong Chumnongsittathum** 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 2019

Secretary-General
Dr. Kom Silapajarn (until September 2019)
Ms. Malinee Smithrithee (since October 2019)
Deputy Secretary-General
Mr. Akito Sato

Training Department (TD)

Chief
Dr. Kom Silapajarn (until September 2019)
Ms. Malinee Smithrithee (since October 2019)
Deputy Chief
Mr. Akito Sato

Marine Fisheries Research Department (MFRD)

Chief, MFRD Programmes
Mrs. Khoo Gek Hoon (until 31 August 2019)
Mr. Ong Yihang (since 1 September 2019)

Aquaculture Department (AQD)

Chief
Mr. Dan D. Baliao

Deputy Chief
Dr. Koichiro Mori

Marine Fishery Resources Development and Management Department (MFRDMD)

Chief
Mr. Raja Bidin Raja Hassan
Deputy Chief
Dr. Kenji Taki (until 31 March 2019)
Dr. Masaya Katoh (since 1 April 2019)

Inland Fishery Resources Development and Management Department (IFRDMD)

Chief
Dr. Arif Wibowo
Deputy Chief
Dr. Takuro Shibuno

OVERVIEW OF SEAFDEC PROGRAMS IN 2019

The activities of SEAFDEC in 2019 were formulated and implemented in line with the policy directives given by the SEAFDEC Member Countries during SEAFDEC annual meetings, *i.e.* the 41st Meeting of the SEAFDEC Program Committee (5-7 November 2018 in Langkawi, Malaysia), 21st Meeting of the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) (8-9 November 2018 also in Langkawi, Malaysia), and the 51st Meeting of SEAFDEC Council (18 - 22 March 2019 in Surabaya, East Java, Indonesia).

SEAFDEC Council of Directors attending the 51st Meeting of the SEAFDEC Council hosted by the Government of Indonesia

The formulation and development of the SEAFDEC programs and activities for 2019 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 2019 were considered and endorsed by the 42nd Meeting of the SEAFDEC Program Committee on 11-13 November 2019 in Chiang Mai, Thailand, and the 22nd Meeting of the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP) on 14-15 November 2019 also in Chiang Mai, Thailand for subsequent submission to the SEAFDEC Council at its 52nd Meeting in 2020.

Participants of the 42nd SEAFDEC Program Committee Meeting (above) *and the discussion during the 22nd Meeting of the FCG/ASSP* (below)

The programs and projects implemented by SEAFDEC in 2019 are shown below:

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
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

Strategy/Project Title	Lead Department	Funding Source
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. Promotion of Countermeasures to Reduce IUU Fishing Activities	TD	JTF
7. Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand	TD	UNEP/GEF
8. Offshore Fisheries Resources Exploration in Southeast Asia	TD	JTF
9. Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region	TD	JTF
10. Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region	MFRDMD	JTF
11. Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region	MFRDMD	JTF
12. Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia	SEC	JAIF
13. SEAFDEC-EU/CITES Sharks Project Phase II	SEC	EU-CITES
14. Strengthening the Effective Management Scheme with GIS (Geographic Information System) & RS (Remote Sensing) Technology for Inland Fisheries and Aquaculture	TD	JAIF
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 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/Project Title	Lead Department	Funding Source
Strategy IV: Enhancing trade and compliance of the region's fish and fishery products with market requirements		
18. 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		
19. 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		
20. Fisheries Resource Survey & Operational Plan for M.V. SEAFDEC 2	TD	JTF
21. Strengthening SEAFDEC Network for Sustainable Fisheries	SEC	JTF
Special Projects		
22. Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia	SEC	Sweden
23. 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. Adapting to Climate Change	AQD	AQD*
4. Maintaining Environmental Integrity through Responsible Aquaculture	AQD	AQD*
5. Meeting Social and Economic Challenges in Aquaculture	AQD	AQD*
6. Priority and Special Projects	AQD	AQD*
7. Promotion on Strengthening of SEAFDEC Visibility and Enhancing Human Capacity Building	TD	TD*
8. Improving of Fisheries Technology and Reduction of the Impact from Fishing Activities	TD	TD*
9. Stock Assessment in Inland Fisheries	IFRDMD	Indonesia

Program Title	Department	Funding Source
10. Development of Capacity Building Plan to support Management of Inland Aquatic Resources, Development of EAFM/EAA Training Modules and Conducting Training of Trainers on EAFM/EAA	IFRDMD	FAO
11. Improve livelihoods from Responsible Fisheries and Capacity for Conservation, by Preserving Clown Knife Fish Habitats and Protecting their Occurrence	IFRDMD	FAO
12. Modernizing Irrigated Agriculture to Protect and Restore Aquatic Biodiversity and Ecosystem Services in Southeast Asia	IFRDMD	FAO

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

3) Other Program

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 2019

The programs of activities of SEAFDEC in 2019 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 have also been guided by the *"Resolution on the Future of SEAFDEC: Vision, Mission, and Strategies Towards 2030"* adopted by the SEAFDEC Council during its special meeting in 2017. Moreover, the programs and activities carried out by SEAFDEC in 2019 had been 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. Furthermore, SEAFDEC also implemented Special Projects which addressed the cross-cutting issues that could not be categorized under particular Strategy. The results and progress of the implementation of programs and activities in 2019, including the Projects under the ASEAN-SEAFDEC FCG/ASSP Mechanism, Departmental Programs and Other Programs, are 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 might have already been overexploited. Through the project "**Offshore Fisheries Resources Exploration in Southeast Asia**" implemented by SEAFDEC/TD since 2015, technical support had been provided by TD to the Member Countries in their efforts to explore the under-utilized fishery resources beyond their coastal areas, including offshore areas in their respective EEZs. This has been made possible through collaborative arrangements for the conduct of research surveys using the M.V. SEAFDEC 2. These surveys had served as platform for promoting the utilization of such fishery resources in a precautionary manner based on analysis of the best available scientific information compiled during the surveys.

Tunas are among the economically important species being targeted by several countries in the Southeast Asian region. To ensure that the region's tuna resources are sustainably utilized and managed, TD has been providing technical support to the Member Countries located around Sulu and Sulawesi Seas, *i.e.* Indonesia, Malaysia, and Philippines for the implementation of the Joint Research Program for Tuna Research Survey in Sulu-Sulawesi Seas, and especially the conduct of stock assessments of yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), and skipjack tuna (*Katsuwonus pelamis*) in Sulu and Sulawesi Seas.

In 2019, TD continued its activities on stock and risk assessments of the aforementioned tuna species as well as other relevant activities toward obtaining better understanding of the offshore fishery resources and promoting the sustainable utilization and management of catch. The "Practical Workshop on Tuna Stock Risk Assessments for Yellowfin Tuna, Bigeye Tuna and Skipjack Tuna Resources in Sulu and Sulawesi Seas (SSSs)" was organized at the premises of SEAFDEC/TD in Samut Prakan, Thailand on 13-18 May 2019, mobilizing an Expert from Japan, *Dr. Tsutomu (Tom) Nishida* as the Resource Person, and making use of the ASPIC Model (or A Stock-Production Model Incorporating Covariates) for stock assessment. Participated by researchers from Indonesia, Malaysia, SEAFDEC/MFRDMD, and TD, as well as observers from TD and Thailand, the Practical Workshop carried out an analysis of the stock structures of the said tuna species using the skipjack otolith samples collected by Indonesia.

Moreover, the "Practical Workshop on Stock and Risk Assessments of Yellowfin Tuna and Skipjack Tuna in the South China Sea using Software on CPUE Standardizations -- ASPIC, Kobe Plots, and Risk Assessments" was also organized at the Research Institute for Marine Fisheries (RIMF) in Hai Phong, Viet Nam on 16-20 December 2019. Also availing of the expertise of *Dr. Tsutomu (Tom) Nishida*, the Practical Workshop which aimed to provide technical support and capacity building on stock assessment to researchers of Viet Nam, was attended by 15 participants from RIMF and three staff members from TD.

Practical Workshop on Tuna Stock Risk Assessment for Yellowfin Tuna, Bigeye Tuna and Skipjack Tuna Resources in Sulu and Sulawesi Seas (SSSs) (13-18 May 2019, Samut Prakan, Thailand)

Practical Workshop on Stock and Risk Assessments of Yellowfin Tuna and Skipjack Tuna in the South China Sea using Software on CPUE standardizations, ASPIC, Kobe plots, and Risk Assessments (16 to 20 December 2019, Hai Phong, Viet Nam)

In addition to the capacity building of researchers from the Member Countries on stock assessment, the Project also provided the opportunities for researchers from TD and the Department of Fisheries (DOF) of Thailand to enhance their capacity in identifying fish larvae samples, especially the species under the Scombridae and Engraulidae families. The technical expertise of *Dr. Yoshinobu Konishi*, expert on fish early life history science from Japan, was availed of when he was on his advisory visit to TD during 1 July - 3 August 2019. The fish larvae species identification exercises made use of the samples that were collected during the 2018 collaborative research survey on marine fishery resources and the marine environment in the Gulf of Thailand.

Parallel with the promotion of sustainable resources utilization, was the promotion of the responsible practices on fish handling at sea which the Project also advocated through

the "Regional Training Course on Fish Handling Techniques Applicable to Various Fishing Operations in Southeast Asia." Organized on 4-8 November 2019 at TD in Samut Prakan, Thailand, the Training was aimed at providing technical knowledge and skills on fish handling techniques applicable to various fishing operations in Southeast Asia, as well as addressing the concerns on hygiene and cleanliness, and the important key factors contributing to the reduction of post-harvest losses on-board fishing vessels. The seven representatives from the ASEAN Member States (AMSs) who participated in the Training had been involved in activities relevant to fish handling in their respective countries, and were expected to serve as trainers on the subject matter upon their return to their countries. With the demonstration and discussion on good practices for fish handling techniques onboard, fish storage, and the ways to improve the fresh quality of catch at landing sites using simple techniques that formed part of the Training, knowledge had been imparted on the appropriate and applicable methods for reducing post-harvest losses onboard fishing vessels, and for maintaining the freshness of the catch.

Participants of the Regional Training Course on Fish Handling Techniques Applicable to Various Fishing Operations in Southeast Asia (4-8 November 2019, SEAFDEC/TD, Samut Prakan, Thailand)

Meanwhile, SEAFDEC/MFRDMD also promoted the sustainable management of marine fishery resources through the Project "**Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region**" that involved the compilation and comparison of annual and/or monthly Catch Per Unit Effort (CPUE) data from purse seine fisheries during the past two decades from eight AMSs, namely: Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam, in order to examine the status and trends of small pelagic resources that are targeted by purse seine fisheries in the region. Implemented from 2013 to 2019, the Project was able to compare the different fisheries management systems, while genetic study of a selected commercially important pelagic species was also undertaken. Thus, the available information including the stock levels were reviewed and the applicable management strategies for sustainable purse seine fisheries in the Southeast Asian region were examined. In order to enhance the knowledge of concerned stakeholders on the concept of sustainable fisheries management, MFRDMD organized the "Fifth Internal Workshop on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region" on 12-14 February 2019 in Kota Bharu, Kelantan, Malaysia. It was agreed during the Workshop that the terminal report including the results of the Project would be published by the end of 2019.

Based on the purse seine catch-effort statistics from eight AMSs compiled from 1996 to 2015, the effort per trip was chosen as the most suitable unit of effort compared with other effort units, while the CPUE was used to examine the status of the pelagic resources. Among the various management systems, it was found that the "Total Allowable Catch (TAC)" system would not be applicable in the context of the multispecies situation of purse seine fisheries in Southeast Asia. However, other measures such as "Production Model"

and “Feedback Control” analyses were found to be more applicable. Although faced with some issues, especially on the reliability of the data considering that some countries could not fulfill all the required parameters established by MFRDMD, the Project was able to deliver to the AMSs the initial outputs, especially on data and information collection, and on the input, output and technical controls for sustainable purse seine fisheries.

Moreover, results from the genetic study of the spotted sardinella *Amblygaster sirm* using *Cytochrome b* and *Cytochrome c* oxidase subunit I (COI) gene markers, revealed two highly genetic divergent stocks, one in Ranong Province (northern Andaman Sea) versus the rest of the populations including those from South China Sea (Muara, Kuantan, Kuching, Kudat, Palawan, Zambales, and Songkla), Java Sea (Pekalongan), and southern Andaman Sea (Banda Aceh). It was therefore suggested that these two stocks should be independently managed. The Project also recommended that further studies should be conducted to examine the possibility that the *A. sirm* population in Ranong could be a cryptic species in the Southeast Asian region.

Samples of Amblygaster sirm *for genetic study*

During the final stage of this Project, MFRDMD organized the “Sixth Internal Workshop on Preparation of Terminal Report for JTF VI Project - Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region” on 13-17 October 2019 in Kuantan, Pahang, Malaysia. Attended by the MFRDMD staff members who were involved in the implementation of the Project, the Workshop discussed the recommendations on the appropriate management measures of purse seine fisheries in the Southeast Asian region based on the results of the Feedback Control and Production Model analyses.

Participants of the 5th Internal Workshop (12-14 February 2019, Kelantan, Malaysia)

Participants of the 6th Internal Workshop (13-17 October 2019, Pahang, Malaysia)

In addition, MFRDMD also organized a Consultation Meeting with the Resource Person of the Project, *Prof. Dr. Takashi Matsuishi* on 19-20 November 2019 in Kuala Lumpur, Malaysia. During the Consultation Meeting, the results of the Surplus Production Model and Feedback Control (Rule 2.2) analyses were finalized for inclusion in the Project Terminal Report which had already been drafted and subsequently reviewed.

Consultation Meeting with the Regional Resource Person, Prof. Dr. Takashi (Fritz) Matsuishi *(third from left)*

The information compiled based on the results of the Project implementation had been disseminated through the "Report on 4th Core Expect Meeting of Comparative Studies on Management of Purse Seine Fisheries in the Southeast Asian Region" which was published in May 2019. In addition, the research paper "A preliminary study of population genetic structure of spotted sardinella, *Amblygaster sirm* in Malaysian waters" was presented by MFRDMD Research Officer, *Ms. Noorul Azliana Jamaluddin* during the International Fisheries Symposium 2019 in Kuala Lumpur, Malaysia on 18-21 November 2019. Furthermore, upon the completion of the Project Terminal Report which is being prepared, this would be disseminated to all the AMSs in early 2020.

Achievements: Comparative Studies for Management of Purse Seine Fisheries

The following facts had been established after the analysis of the compiled data on purse seine fisheries had been carried out through the Project **"Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region:"**

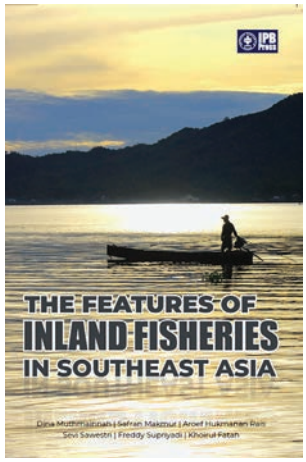
- Adoption of the "Production Model" and "Feedback Control" analyses was considered more applicable compared with the "Total Allowable Catch (TAC)" system as this could not be applied in the context of the multispecies situation of purse seine fisheries in the Southeast Asian region, also considering that the Production Model would enable the AMSs to determine the optimum level of effort (fMSY) when there is sufficient and reliable catch and effort data, while the Feedback Control (Rule 2-2) could be used to determine the Allowable Biological Catch (ABC) if the data are insufficient
- Results of the analysis using the Production Model (Fox) analysis indicated that exploitation of the pelagic resources by purse seiners in Brunei Darussalam, Malaysia, and Thailand is already at sustainable level, thus increasing the fishing effort is not recommended, while the pelagic resources in Indonesia (SCS) is already beyond the sustainable level, therefore, fishing effort should be reduced as much as possible until one third (1/3) of the current effort is reached
- Use of Production Model and Feedback Control should be replicated in the future projects after improvements of data collection have been made, as insufficient data and information would only decrease the accuracy of the results of the stock assessment analysis

- Results of the genetic study of *Amblygaster sirm* revealed two highly genetic divergent stocks: Ranong (northern of Andaman Sea) *versus* the rest of the populations (South China Sea, Java Sea, Celebes Sea and southern part of Andaman Sea), implying that these stocks should be independently managed
- Further studies should be carried out to examine the possibility that *A. sirm* in Ranong could be a cryptic species in the Southeast Asian region

1.2 Assessment and management of inland fisheries

Inland aquatic resources in Southeast Asia are very rich in biodiversity, making inland fisheries one of the most important economic components in the region, contributing to the socio-economic development of rural communities, particularly in terms of poverty alleviation, food security and nutritional well-being. Considering that inland fisheries is not the only sector that has interest in the inland water bodies but could also include other development sectors, more attention should be paid to securing the sustainability of inland fisheries. To support the sustainable development of inland capture fisheries, SEAFDEC/IFRDMD implemented the Project "**Promotion of Responsible Utilization of Inland Fisheries in Southeast Asia**" from 2015 to 2019, which was 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.

After reviewing the activities for promoting inland fisheries and taking into consideration the series of surveys in the AMSs conducted through the Project, and from the literature review undertaken during the past years, IFRDMD produced and launched in October 2019, the publication "The Features of Inland Fisheries in Southeast Asia" describing large numbers of inland water bodies distributed in the region that generate fisheries production and serve as important sources of animal protein for the people. The publication also contains information on capture fisheries in inland waters that provide employment opportunities and revenues to millions of people in the rural areas, and also depicts the nature of activities that vary by areas where the fishing activities occur, the aquatic species being targeted, fishing gear used, as well as the respective social cultures of the AMSs.



Furthermore, with the objective of seeking and promoting the effective management measures for the sustainability of inland fisheries, the length and weight of three species of economically important freshwater fishes, *i.e.* snakehead (*Channa striata*), Boeseman croaker (*Bosemania microlepis*), and peacock eel (*Macrognathus siamensis*) from Tonle Sap Great Lake in Cambodia were collected from May 2018 to May 2019. Based on the analysis of the data collected, IFRDMD came up with recommendations to regulate the catch of peacock eel, *e.g.* choosing alternative fishing gears, establishing conservation zones, and

restocking of native fish species, to avoid depleting the resource due to uncontrolled catching activities.

In another project site in Nam Xouang Reservoir in Lao PDR, the daily data of fish catch and fishery production of the marble goby (*Oxyeleotris marmorata*), Malayan leaffish (*Pristolepis fasciatus*), dusky face carp (*Osteochilus lini*), and *Labiobarbus leptocheilus*, were collected as well as the information on biological parameters, from June 2018 to May 2019. Results of the analysis of the data indicated that fisheries in Nam Xouang Reservoir still have the potentials to expand since the Reservoir has high fish diversity, while the local communities have also been cooperating with the government in utilizing the fishery resources in a sustainable manner. Nevertheless, the exploitation rate of some species appeared to be at a critical point and thus, should be controlled, *e.g.* by considering the use of appropriate fishing gears and enforcing closed season during the spawning of the fish species, and establishing conservation zone for the economically important species. Moreover, the appropriate mesh-size of particular fishing gears was also recommended to enhance gear selectivity and avoid by-catch. Results of the one-year data collection including the issues and concerns with the recommended actions were presented during the meeting convened by IFRDMD on 24 July 2019 with the representatives from the local government and fishery management community at Nam Xouang Reservoir, and the enumerators in attendance. Subsequently, the activity was continued by monitoring the status of the conservation zone which was established in Nam Xouang Reservoir since October 2018.

Meeting with local government, enumerators, and fishery management community to discuss the results of data analysis (4 July 2019, Nam Xouang Reservoir, Lao PDR)

In the other site of the Project at Kotopanjang Reservoir in Riau Province, Indonesia, fisheries data was collected from May 2018 to April 2019, and comparing the fishing rate in Kotopanjang Reservoir with those of other places, and it was found that there was no difference in the fishing rate. However, differences in fishing rates could possibly occur when there are changes in the ability, habit, or environmental condition that affect the periodical installation of the fishing gears, considering that fishers in Kotopanjang Reservoir usually discard their fishing gears and replace these when broken or torn, or disappeared and lost.

Considering that data collection is a fundamental process of the entire field management procedures in inland fisheries, IFRDMD developed a method to facilitate data collection using a software or web-based application called “Data Collection of Fishery Activities” or “DACOFA.” Through this application, data collectors at the field can key-in the data/

information collected, and the IFRDMD researchers can have real-time access to such data/information from their offices.

To enhance the capacity of the AMSs in the management of inland fisheries towards sustainability, IFRDMD in collaboration with the Department of Livestock and Fisheries of Lao PDR organized the "Regional Training Course for the Improvement on the Management of Inland Fisheries" on 25-26 July 2019 in Vientiane Province, Lao PDR. Attended by participants from Cambodia, Lao PDR, Myanmar, Viet Nam, Thailand, and Indonesia, the Training had *Prof. Dr. Sonny Koeshendrajana*, Senior Researcher from the Centre for Marine and Fisheries Social and Economics Research of Indonesia as Resource Person. After learning more about the application of Ecosystem Approach to Fisheries Management (EAFM) for improving the management of inland fisheries, the participants continued to discuss a case study and analysed the problems of inland fisheries management based on the ecosystem approach concept.

Participants in the Regional Training Course for the Improvement on the Management of Inland Fisheries (25-26 July 2019, Vientiane Province, Lao PDR)

Capacity building for its Departmental staff had also been promoted by IFRDMD on various aspects toward achieving their roles and responsibilities within the Department. Such activities include among others, the "In-house Training on Inland Fisheries and Biodiversity in Southeast Asia" on 23 September 2019 in Palembang, Indonesia with the collaboration of the Research Institute for Inland Fisheries and Extension (RIIFE). With *Prof. Yoshinori Kumuzawa* from Nagoya City University of Japan as the Resource Person, the participants learned about the "Evolution and Biodiversity of Southeast Asian Freshwater Fishes" as presented and discussed by *Prof. Kumuzawa*. Moreover, the "In-house Training on Drone and its Utilization on Inland Fisheries" on 18-20 November 2019 in Palembang, Indonesia, with *Mr. Beginer Subhan* and *Mr. Prakas Santoso* from the Institut Pertanian Bogor (IPB) University as Resource Persons, provided the necessary skills in taking videos and pictures using drone, as well as in analyzing and interpreting the results.

With the objective of disseminating the results of work undertaken by IFRDMD since its establishment in 2014, IFRDMD organized the "Workshop on 5-year of IFRDMD's

Achievement" on 8-9 October 2019, in Jakarta, Indonesia, which was attended by officers and experts from the AMSs, regional experts from Indonesia, as well as staff from the SEAFDEC Secretariat and IFRDMD. At the Workshop, IFRDMD's researchers presented the results of their studies during the past five years. Subsequently, the Workshop identified the problems and challenges in collecting data related to inland fisheries, and synthesized the lessons learned, including those for improving fisheries information gathering on inland fisheries at the regional level. On 8 October 2019 and as part of Workshop activities, Indonesia represented by IFRDMD and SEAFDEC presented the **Lifetime Achievement Award** to *Dr. Chumnarn Pongsri*, former Secretary-General of SEAFDEC during 2009-2015, for his work on inland fisheries research and management.

Participants of the Workshop on 5-year of IFRDMD's Achievement (8-9 October 2019, Jakarta, Indonesia)

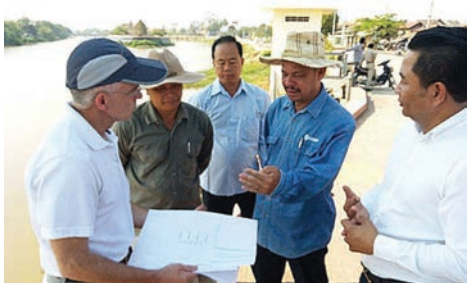
Lifetime Achievement Award presented to Dr. Chumnarn Pongsri*, former Secretary-General of SEAFDEC for his work on inland fisheries development*

Furthermore, some staff of IFRDMD staff had been invited as Resource Persons in various events, *e.g.* two international classes hosted by the Research Institute in Indonesia, workshop organized by an Indonesian university. Researchers from IFRDMD also shared the results of their work at several fora, such as the "Regional Workshop on Facilitating Fisheries Activity Information Gathering Through Introduction of Community-based Resources Management/Co-management in Southeast Asian Region" organized by TD on 22-24 October 2019 in Sakon Nakhon Province, Thailand; "Inland Fisheries Technical Support Meeting" supported by Marino-Forum 21 (MF21) on 30 August 2019 in Tokyo, Japan; and the "Workshop on Lessons Learned on Inland Fisheries Management in Southeast Asia" on 3 December 2019 in Palembang, Indonesia.

Staff of IFRDMD serving as Resource Person in an international class hosted by the Research Institute of Indonesia

In another development and in an effort to enhance the sustainability of inland fishery resources by mitigating the impacts of cross-river constructions, the Project "**Implementing the Lower Mekong Fish Passage Initiative in Cambodia, Thailand, and Viet Nam**" was implemented by TD from 2018 to September 2020. With support provided by the United States Department of Interior (US-DOI) and the United States Agency for International Development (USAID), the project is aimed at building the capacity of the SEAFDEC and Lower Mekong River Basin nations to construct and maintain low head fish passes to restore the fisheries connectivity at irrigation facilities, weirs, and road prisms.

For ***Cambodia***, and after the construction of fish passage was completed in May 2019, TD with support from the Inland Fisheries Research and Development Institute (IFReDI) of Cambodia conducted five monitoring trips from May to November 2019, covering the period from wet season water flow until the dry season water flow. The preliminary results showed that about 56 to 62 fish species passed through the fish passage as observed during the monitoring trips. The IFReDI would also analyze the recorded data and prepare the final report for submission to the FiA, USAID, US-DOI, SEAFDEC, and MRC. The ownership of the fish passage was transferred to Pusat Province through a hand-over ceremony on 9 October 2019, which was attended by representatives from the US Embassy in Cambodia representing the USAID, as well as from Pusat Province as recipient of the fish passage, through the Undersecretary of State of the Ministry of Agriculture of Cambodia.



Site inspection by USAID/DOI representatives, of the fish passage construction in Cambodia (from 17 to 22 February 2019)

Transfer of ownership of fish passage to Pusat Province of Cambodia through Undersecretary of State, Ministry of Agriculture of Cambodia

For ***Thailand***, and after the survey conducted by TD in cooperation with the Department of Fisheries (DOF) of Thailand for fish passage construction, the "Huay Wang Chang Weir" in Udonthani Province was proposed as a demonstration site. During the meeting with the public sector around Huay Wang Chang Weir in Sangkhom Municipality on the proposed construction of fish passage, convened on 18-19 March 2019, it was agreed that the construction should be managed by a local construction company in December 2019. Subsequently, the USAID/DOI sent the fish passage engineer to the site on 11-14 December 2019 to assess the area and discuss with the local construction company and DOF working team on the construction which was agreed to take approximately 120 days after the signing of the construction agreement.

Meeting with public sector around Huay Wang Chang Weir, Sangkhom Municipality in Udonthani Province on the proposed construction of fish passage (18-19 March 2019)

Fish passage engineer sent by USAID/DOI discussing with local constructor and DOF fish passage working team at the Hauy Wang Chang Weir in Udonthani Province, Thailand (11-14 December 2019)

For ***Viet Nam***, the "Ea Tul Weir" in Dak Lak Province was selected as a demonstration site for the fish passage construction, to be carried out by the Provincial Department of Agriculture and Rural Development (DARD) starting December 2019. Prior to the construction works, the USAID/DOI also sent the fish passage engineer on 8-11 December 2019, to discuss with the Provincial DARD of Dak Lak Province and D-Fish working team on the arrangements of the fish passage construction at Ea Tul Weir.

In furthering the efforts of SEAFDEC toward enhancing the understanding of stakeholders on inland fisheries development and management, the project "**Strengthening the Effective Management of Inland Fisheries and Aquaculture in AMSs with GIS (Geographic Information System) & RS (Remote Sensing) Technology**" had been initiated. Supported by the Japan-ASEAN Integration Fund (JAIF), the Project which was set for 18-month duration from January 2019 until June 2020 is aimed at developing the methods for monitoring inland fisheries and aquaculture using GIS Mapping and RS Technology, and investigating the relationship between the amount of catch and the environmental data through GIS Mapping. Five (5) sites in the AMSs had been selected for the Project, namely: in Cambodia (Tonle Sap Great Lake), Indonesia (Sentarum Lake), Lao PDR (Nam Ngum Reservoir), Myanmar (Akwi In), and Thailand (Bangrakum floodplain). At these sites, the activities would focus on: 1) collection of environmental data from satellites which might be related to amount of fish catch; 2) collection of fishery catch data using logbook of fishers in five selected sites of the five AMSs; and 3) analysis of the relationship between environmental factors and the amount of catch. In addition to collection of catch data, historical catch data had also been compiled as these could also contribute to the investigation of the relationship between the amount of catch and the environmental data with the GIS Mapping.

In 2019, at each of the project sites, fishers had to fill-in data into the logbook, *i.e.* fishing areas, fish species, and amount of catch into the logbook on daily basis, and submit the logbook to enumerators and subsequently to focal point of each country and SEAFDEC. Prior to recording in the fishing logbooks, surveys were carried out in the project sites to collect baseline information on the type and number of fishing gear, fishing season, peak fishing season, dominant fish catch and commercially-exploited local fish species. In addition to catch data recorded on the logbook, historical fisheries data from the selected sites (except Myanmar since data was not available) and environmental data, such as geographical and inland aquatic organism habitats based on satellite images and other available information, were also compiled.

The summary of the outputs of the Project in 2019 was presented during the "Working Group Meeting on Collecting Data and Analysis and Aquaculture in AMSs with GIS and RS Technology" organized by SEAFDEC on 28 November 2019 in Vientiane Province, Lao PDR. More specifically, the progress made in catch data collection using logbook, and compilation of historical fisheries data and environmental data based on satellite images, were also reported for the different project sites. As planned, upon completion of the data collection by March 2020, SEAFDEC in collaboration with TUMSAT (assisting in the data analysis) would proceed with the analysis that may reveal the relationship among the geographical/environmental data and the catch data, and a technical manual on data analysis using GIS Mapping/RS Technology would be prepared.

Baseline survey of fishing gear in Lao PDR

Orientation of fishers on recording of fisheries data in logbooks

Working Group Meeting on Collecting Data and Analysis and Aquaculture in AMS with GIS and RS Technology (28 November 2019, Vientiane Province, Lao PDR)

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 substantial efforts in the development and implementation of measures to combat Illegal, Unreported and Unregulated (IUU) fishing. At the regional level, SEAFDEC has been taking the leading role in the development and promotion of regional measures and tools for combating IUU fishing. Toward this end, TD has continued to implement a series of activities under the project "**Promotion of Countermeasures to Reduce IUU Fishing**" since 2013; and in 2019 which is the final year of this Project, focus was placed on updating the Database for the Regional Fishing Vessels Records (RFVR) for vessels 24 meters in length and over, and supporting the regional cooperation for the implementation of Port State Measures (PSM).

As for the **RFVR**, since the endorsement of the compilation of RFVR for vessels for 24 meters in length and over, by the ASEAN through the Special SOM-34th AMAF in 2013, and the development of the RFVR Database in the subsequent year, TD has continued to update the RFVR Database based on the fishing vessels data provided by the AMSs. On the occasion of the "Fifth Meeting of the Global Record Informal Open-Ended Technical and Advisory Workshop Group (GRWG5)" convened by FAO on 13-14 May 2019 in Seoul, Republic of Korea, TD also organized a side event on RFVR in Southeast Asia where discussions were made on the need to update the RFVR Database for vessels 24 meters in length and over, the possibility of expanding the RFVR Database to also cover vessels less than 24 meters in length, and strengthening of cooperation between SEAFDEC and the Food and Agriculture Organization of the United Nations (FAO), especially in sharing of information from the RFVR Database to the FAO Global Record of Fishing Vessels, Refrigerated Transported Vessels and Supply Vessels (Global Record) in the future. During the side event, where the progress of the updated information on the Database for vessels 24 meters in length and over was discussed, the way forward for the development of Database for vessels less than 24 meters in length in the future was also brought up, while the future SEAFDEC and FAO cooperation on sharing of information on the RFVR with the Global Record was proposed. Such recommendations were reported to the 22nd Meeting of the FCG/ASSP in November 2019, where it was suggested that SEAFDEC should consult with the AMSs during a technical meeting planned for 2020 and come up with an agreement on the appropriate size ranges for vessels less than 24 meters in length to be included in the Database, as well as the mechanism for harmonizing the submission of data on fishing vessels from the AMSs to SEAFDEC, and also to FAO in the future.

Meeting on RFVR in Southeast Asia organized as side event during the Fifth Meeting of the Global Record Informal Open-Ended Technical and Advisory Workshop Group (GRWG5) in the Republic of Korea

With regards to the **regional cooperation for the implementation of PSM**, TD continued its efforts to strengthen the PSM and other surveillance measures in the region by organizing the "Regional Training on Port State Measures (PSM) Implementation for Inspectors in Southeast Asia" on 22-26 July 2019 at the TD premises in Samut Prakan, Thailand. Conducted in collaboration with and mobilizing expertise from partner organizations, such as the Department of Fisheries (DOF) of Thailand, Australian Fisheries Management Authority (AFMA), National Oceanic and Atmospheric Administration (NOAA), FAO, and the USAID, the Training had served as an avenue for sharing of information on the current situation of inspection practices for port control and PSM among the AMSs and the resource persons.

Discussions during the Regional Training on Port State Measures (PSM) Implementation for Inspectors in Southeast Asia (22-26 July 2019, Samut Prakan, Thailand)

Study trip of participants in the Regional Training on PSM to observe the PSM inspection onboard tuna carrier vessels

In a related development, TD also continued to promote the application of the **ASEAN Catch Documentation Scheme (ACDS)** as means of preventing the entry of fish and fishery products from IUU fishing activities into the supply chain. The electronic ACDS (eACDS) application was developed and pilot tested first in Brunei Darussalam since 2017, and expanded in 2019 to other countries, *i.e.* Viet Nam, Myanmar, and Malaysia. *(see 4.1 Development and promotion of traceability system for fish and fishery products in the region)*

Achievements: Combating IUU fishing in the Southeast Asian region
Regional tools and initiatives were developed and established toward combating IUU fishing, through the Project "**Promotion of Countermeasures to Reduce IUU Fishing**" and other relevant projects implemented by SEAFDEC in close consultation and coordination with the AMSs. These include: • Regional Fishing Vessels Record (RFVR) for vessels 24 meters in length and over – a regional database that facilitates exchange of information among the AMSs on registered fishing vessels and carrier vessels measuring 24 meters in length and over • Regional Cooperation for the Implementation of Port State Measures (PSM) – a regional collaborative framework to enhance the capacity of AMSs in the implementation of PSM and prevent the landing of fish and fishery products from IUU fishing activities • ASEAN Catch Documentation Scheme (ACDS) – a regional concept toward improving traceability of marine capture fisheries with the aim of preventing the entry of fish and fishery products from IUU fishing activities into the supply chain • Regional Plan of Action for Management of Fishing Capacity – a regional policy framework that encourages the respective AMSs to establish registration and licensing systems that are fundamental for combating IUU fishing

- Sub-regional platform to facilitate discussion and come up with agreement among countries in the sub-regions, on priority issues and actions that require coordination among countries in the respective sub-regions, *e.g.* Gulf of Thailand, Andaman Sea, Sulu-Sulawesi Seas

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

In the Southeast Asian region, the available fishery statistics on coastal and inland fisheries had been recognized as under-reported due to the nature of these fisheries, being multi-species and involving large numbers of small-scale fishers. Nevertheless, considering that the availability of reliable statistics and information is crucial to support the sustainable development and management of fisheries, it has become necessary that the methodology for collecting the data and information should be improved. One of the approaches being promoted by SEAFDEC to address such concern is the adoption of the concept of Community-based Resources Management (CBRM) and co-management, as it enhances the involvement of fishers, 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. Thus, the Sub-project "**Facilitating fisheries activity information gathering through introduction of Community-based Resources Management/Co-management**" was formulated and implemented by TD since 2013 under the Project "**Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region.**" 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. From 2013 to 2019, the Sub-project was implemented in three pilot countries, *i.e.* in Cambodia, Lao PDR and Thailand, Nevertheless, as the activities in Cambodia had been completed and reported in 2018, this report covered only the activities carried out in 2019 in Lao PDR (Nam Xouang Reservoir and Khammouane Province) and in Thailand (Nam Oon Reservoir in Sakon Nakhon Province).

For the pilot site in **Nam Xouang Reservoir in Vientiane Province, Lao PDR**, the activities in 2019 focused on following up with what had been started in the previous years, *e.g.* establishment of Fisheries Management Committee (FMC), development of fisheries management plan, and establishment of mobile hatchery system to produce fish fingerlings for the Reservoir. Specifically, TD organized a series of activities to continue monitoring and facilitating the CBRM/co-management at the project site, and a local meeting was organized from 17 to 23 March 2019 to enhance the awareness of fishers, local communities' members and local fishery officers on the importance of fisheries co-management including the enforcement of the established community rules and regulations, and to distribute extension materials such as posters and brochures to the communities around the Reservoir. From 23 to 26 July 2019, TD also promoted the need to strengthen the Monitoring Control and Surveillance (MCS) measures at the Nam Xouang

Reservoir, and supported the Reservoir Patrol Unit by providing them with an engine-powered boat for their surveillance activity. From 23 to 26 September 2019, TD facilitated the conduct of a study trip to other similar pilot areas for the Nam Xouang FMC members to strengthen their capacity by sharing knowledge and experiences among the FMCs from the other areas, especially on the success cases of fishery management systems and alternative livelihood opportunities. As a result, the Nam Xouang FMC members gained lessons and obtained additional knowledge which they had mobilized to enhance their patrolling system and resources management in the Nam Xouang Reservoir. The women's group, on the other hand, after obtaining new ideas and knowledge on fish processing, established a "Fish Processing Group" in Naxaythong and Phone Hong District of the Reservoir. Upon the establishment of such Fish Processing Group, TD continued to support the Group by conducting training courses and practical workshops on fish processing techniques, and also provided the initial equipment needed for their fish processing ventures. This has enabled the Group to start their fish processing business since December 2019, by producing several kinds of fishery products for sale within the village.

Local meeting provides knowledge on fisheries co-management including the community rules and regulations, facilitated through the extension materials, such as posters, brochures distributed to the communities around Nam Xouang Reservoir

For the other pilot site in **Khammouane Province in Lao PDR**, TD continued to promote alternative livelihood programs through the FMC of Mai Nam Pakan Village which was established in early 2018, by formalizing its "Aquaculture Group." This gave the Mai Nam Pakan FMC members the opportunity to enhance their capacity in generating additional incomes and reducing fishing efforts and pressure to the resources. In support of the activities of the Aquaculture Group, TD organized the training on catfish culture techniques from 29 April to 4 May 2019, which was attended by 12 Group members and another 10 community members. With the skills they learned and experiences gained from the aquaculture trials, the participants should be able to transfer the fish culture techniques to neighboring villages to also support their livelihoods. Moreover, through the Project, TD also supported the construction of cement ponds on 2-4 September 2019, for catfish culture and provided fish fingerlings and fish feeds for the aquaculture activity. Subsequently, on 3-6 December 2019, TD monitored the progress of the activities of the Mai Nam Pakan FMC, specifically the catfish culture and fish processing. The catfish culture group revised the rules and regulations for group management and the roles and responsibilities for operating fish culture. The group members also had the confidence to continue the activity

after gaining experience and obtaining income that could be invested for the next run of catfish culture. The fish processing group on the other hand, planned to produce fish products once a week and allocate the profit to its members every six months, while the FMC closely monitors the fish processing operations and accounting system of the group. The group also constructed a small hut for selling the products produced by the group. In one of their visits, the Project team encouraged the local community to continue their activities to conserve the fishery resources for sustainability.

In order to review and summarize the project activities implemented in the abovementioned two project sites, the "End Project Meeting of Lao PDR Project Site" was convened on 24-25 December 2019. The Meeting served as avenue for the fisheries officers and FMC members from the two project sites to share the lessons learned from their activities which could also be applicable not only in their respective communities but also in the other areas of the country. The issues and concerns encountered during the implementation of the activities were also identified and possible solutions suggested.

Study trip for the Nam Xouang FMC members on 23-26 September 2019 to share knowledge and experiences among the FMCs from other areas on the successful cases of fishery management systems and alternative livelihoods

End Project Meeting of Lao PDR Project Site on 24-25 December 2019 to review and summarize the project activities conducted at the two Project sites in Lao PDR

Meanwhile, in the pilot site at **Nam Oon Reservoir in Thailand**, TD conducted a dialogue with officers from Sakon Nakhon Provincial Fisheries Office, fisheries officers from the DOF of Thailand Headquarter, and local officers from Nam Oon Dam Fisheries Patrolling Unit on 4-7 March 2019, to obtain updates of the progress in the project implementation at Nam Oon Reservoir, and review the fisheries management measures for the Reservoir. On 21-24

Dialogue with local partners on 4-7 March 2019 discussed the updates on the current situation and reviewed the fisheries management measures of Nam Oon Reservoir

Local meeting on 21-24 May 2019 reviewed and discussed the results of data collection using logbook and stock assessment, as well as disseminated the rules and regulations on closed season, and types of fishing gear prohibited in Nam Oon Reservoir

May 2019, a local meeting was organized for communities around Nam Oon Reservoir to discuss the results of the data collection using logbook and stock assessment, as well as to inform the communities about the fisheries rules and regulations, *i.e.* closed season and the types of fishing gear prohibited in Nam Oon Reservoir.

In the final year of the Project in 2019, TD organized the "Regional Workshop on Facilitating Fisheries Activities Information Gathering Through Introduction of Community-based Resources Management/Co-management in the Southeast Asian Region" from 22 to 24 October 2019 in Sakon Nakhon Province, Thailand to review the results of the project activities and share the lessons learned, not only from the Project but also from other relevant national initiatives, among the AMSs in the promotion of CRBM/Co-management for improving the collection systems for coastal and inland fisheries data and information. The Workshop also discussed and identified the key factors for successful fisheries information and data collection through the implementation of CBRM/Co-management, as well as recommendations on future activities toward the promotion of effective fisheries data collection through CBRM/co-management.

Participants of the Regional Workshop on Facilitating Fisheries Activities Information Gathering Through Introduction of Community-based Resources Management/Co-management in the Southeast Asian Region (22 to 24 October 2019, Sakon Nakhon Province, Thailand)

Achievements: Facilitating fisheries information gathering through community-based resources management/co-management
The implementation of the Project "**Facilitating fisheries activity information gathering through introduction of Community-based Resources Management/Co-management**" during 2013-2019, had supported the AMSs in applying Community-based Resources Management (CBRM) and Co-management as practical approaches for information gathering on coastal small-scale and inland fisheries. In pilot sites in Cambodia, Lao PDR, and Thailand, their respective fisheries community members had successfully enhanced their knowledge of the concept of the CBRM and co-management, and continued to support the activities of their respective Fisheries Management Committees (FMCs). The respective FMCs had established relevant rules and regulations, as well as fisheries management measures, have been established and disseminated through community consultations and dialogues, taking into consideration the data and information collected through the communities' participations in using logbook, etc. The communities were able to carry out alternative livelihood programs generating additional incomes and at the same time reducing the fishing pressures on the available resources and providing the assurance that the resources are utilized in a sustainable manner.

1.5 Development and promotion of responsible fishing technologies

In the Southeast Asian countries, the well-being of people engaged in coastal and marine fishing activities needs to be enhanced as these people had been confronted with challenges, especially the measures on safety at sea that seem to be inadequate, and the living and working conditions onboard the fishing vessels that could be below standard. Furthermore, considering that fuel takes up most of the operational costs for fishing activities, impacting on the revenues and livelihoods of fishers, while the use of carbon-based fuel also generates greenhouse gasses resulting in the considerable impacts of climate change, TD implemented the regional project "**Optimizing Energy Use/Improving Safety in Fishing Activitie**s" to address the abovementioned concerns by transferring the appropriate knowledge and enhancing the awareness on optimizing energy use in fishing activities, and promoting the concept of safety at sea for small fishing vessels in the AMSs. Thus, starting in 2013, TD conducted relevant R&D activities and organized a number of on-site training courses in the AMSs to transfer the appropriate knowledge and enhance awareness on optimizing energy use in fishing activities and safety at sea for fishing vessels. The FAO/ILO/IMO Publication "Safety Recommendations for Decked Fishing Vessels of Less than 12 Metres in Length and Undecked Fishing Vessels" was translated into various languages, *i.e.* Cambodian, Indonesian, Malaysian, Burmese, Filipino, Thai, and Vietnamese, and promoted to the respective countries for use by their fishers. In the final year of the Project in 2019, and to conclude the activities undertaken throughout the past years, TD organized the "Regional Review Training Program on Optimizing Energy and Improve Safety at Sea for Small Fishing" on 5-9 August 2019. Attended by 15 participants from 7 AMSs, the training reviewed the current situation, existing methods and techniques for optimizing energy use, and the overview of safety at sea for fishing activities. The lessons learned from

several case studies related to the methods and techniques at regional and national levels were also discussed.

Training program on optimizing energy use and safety at sea (5-9 August 2019, Samut Prakan, Thailand)

TD also advocated that energy-efficient use (energy optimization) in fishing activities could be achieved through the improvement of vessels, gears, and types of equipment related to the fishing operations. Considering that fisheries machinery, fish preservation, and propulsion system are essential during the fishing operations of the fishing vessels, TD has been developing the techniques that are effective and efficient, leading to energy optimization for the benefit of fishers. One of such techniques involves the use of power takeoff to support the operation of the crane, power block, nets drum, and refrigeration system of fishing vessels.

In 2019, TD resumed the activity that had been postponed from 2018, on the improvement of fish handling onboard tuna purse seiners by making use of a Thai purse seiner at the project site in Pattani Province, Thailand (Cold Chain Onboard). The simple refrigeration system designed by TD produces a cooling medium that prevents heat accumulation in fish holds. It was set-up in Thai purse seine fishing vessel to promote the adoption of what is known as RSW Chilling System, considering that the use of such system would not only prolong the freshness of the catch during on-board transportation but also reduce post-harvest losses onboard the fishing vessels.

In addition to the issues on safety and working conditions of fishers at sea, another big challenge faced by the fisheries sector of several Southeast Asian countries during the recent years, is shortage of crew onboard fishing vessels. TD has been undertaking efforts to address this concern with the collaboration of the DOF of Thailand, by embarking on an activity that involves exploring the possibility of developing 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 Labour Organization (ILO) Convention 188: Work in Fishing (C188). TD also organized a Workshop in 2018 to exchange views on the concept of appropriate fishing vessels' design to support fuel efficiency, safety at sea, good working and living conditions as well as minimum manpower onboard fishing vessels. As a follow-up, TD organized a "Meeting-Workshop on Appropriate New Trawl and Purse Seine Fishing Vessel Design" on 18 February 2019, to gather views on the appropriate design of trawl and purse seine fishing vessels from relevant industries, *i.e.* Thailand Fishery Association, Fishery Associations of Samut Sakhon, Pattani, and Trat Provinces through the Shipyard/Shipbuilding, the Federal

of Thai Industries, etc., promote energy efficiency and safety at sea, and improve the working/living conditions onboard fishing vessels. Based on the conceptual design as discussed and agreed during this Meeting-Workshop, TD developed the drawing plans and construction models of the new version of trawl and purse seine fishing vessels, which were subsequently to the DOF of Thailand on 29 August 2019.

The Meeting-Workshop on 18 February 2019 with relevant industries, came up with the appropriate design of trawl and purse seine fishing vessels

TD representatives delivering to the DOF Thailand on 29 August 2019, two drawing plans and models of the improved version of trawl and purse seine fishing vessels

As early as 2018, TD had discussed with the DOF of Thailand and the Thai Fisheries Association as well as with a local purse seine owner in Pattani Province, for the implementation of the activity "Purse Seine Net Modification Using Net Hauler and Deck Machinery" aiming to facilitate the adoption of techniques for improving fishing operations that include optimizing energy use, improving safety at sea and working conditions onboard, and reducing the requirements for fishing crew onboard. Under this activity, TD developed a net power block and deck machinery that would reduce the number of crew required for fishing operations, that were installed in a pilot Thai purse seiner the "*Nor Larpprasert 8.*" In addition, an on-board cold storage system was also improved with a view to elevating the quality and freshness of the catch as well as its safety for human consumption. Sea trial of this pilot vessel was conducted on 22-26 April 2019 in Pattani Province, and another trial on 16-17 June 2019 in Trat Province, to gather initial data on the cost and returns from the fishing boat modifications/operations. From the interview of the fishing crew onboard "*Nor Larpprasert 8,*" the use of net hauling with hauler machinery was much easier than human power, while the working conditions of the crew had also been improved with more time and space for resting. Furthermore, from the discussion with the vessel owner, it was found that although the investment cost for the ship's reconfiguration is relatively high, such reconfiguration could primarily focus on the fishing equipment, such as crane, power block, and hydraulic system. Meanwhile, the central cooling system, refrigeration

system and purchase of whole set of purse seine nets, are not necessary for the primary reconfiguration, thus, could be gradually added later on. On 13 August 2019, launching of "*Nor Larpprasert 8*" as the pilot vessel under this purse seine fishing vessel modification project was conducted in Pattani Province, Thailand, as a collaborative effort between Pattani Provincial Association, the owner of pilot fishing vessel and the Department of Fisheries of Thailand.

In a parallel development, TD with financial support from the Japanese Trust Fund (JTF), introduced the installation of auxiliary machinery onboard to support the fishing vessels' operations, *e.g.* hydraulic crane, net hauler (power block), and the development of hygienic fish handling and storage system using the refrigerated sea water (RSW). While the owner of the pilot fishing vessel was responsible for the cost of the vessel modification to suit the installation of the equipment (*i.e.* the auxiliary machinery) as well as the cost of purse seine nets modification, JTF provided the funds to defray the cost of the equipment. The installation of the equipment on the pilot vessel (Nor Larpprasert 8) took two (2) months to complete due to the extensive renovations made, not only in terms of technical support but also the transfer of technology, *e.g.* optimizing energy use, improvement of fishing gears, installation of fishery machinery and fish handling technique onboard for preserving the fresh quality of the catch that would be supplied to the market.

Thai traditional purse seine fishing vessel hauling the net from both sides, port and starboard sides with nearly 40 crew members onboard (before installation of modern fishing machinery)

Thai purse seine fishing vessel hauling net only from starboard side with only 16 crew members onboard after installation of modern fishing machinery, e.g. hydraulic crane, power block and refrigeration seawater cooling system (RSW) with modification of the net plan

Improvement of purse seine net based on design with improved deck machinery for the pilot Thai purse seiner in Pattani Province

Data collection for economic analysis of the performance of Thai purse seine fishing vessel equipped with power block system for hauling net

Demonstration during the launching of the newly-equipped "Nor Larpprasert 8" on 13 August 2019

Following-up on this purse seine modification activity, TD carried out a study to evaluate the economic viability of the modified purse seine vessel by comparing the cost of vessel modification and the savings from the long-term reduction in operation costs. Such savings could come from the reduction of manpower onboard the vessels, installation of improved cooling system, etc. In addition, such costs should also be compared with the impacts of the improvements on the social well-being and livelihoods of fishers.

After providing/installing the auxiliary machinery to support the purse seine fishing operations, *e.g.* hydraulic crane, net hauler (power block), fish handling and storage system (RSW), the number of crew onboard was reduced by more than 40%. The overall operations have been smoothly carried out by the skillful master fisherman who is active and with good leadership personality. The newly installed power-block system and the refrigerated seawater system (RSW) worked properly even when operating under severe conditions. The RSW system has the capacity to produce eight (8) tons of seawater from ambient temperature of 28°C down to -2°C within 12 hours, while the temperature of chilled water in the fish storage room was maintained as well. When the systems ceased for 24 hours, the water temperature in the storage room increased from -2°C to only 4°C. The data collected from the sea trial revealed that the total amount of fish catch which was approximately 8,800 kg, was supported by the RSW system that maintains the temperature between -2°C to 4°C until the vessel arrives the landing site. It is expected that by combining the use of manpower saving device like hydraulic net hauling device (power-block) and the RSW system, reduction of the number of crew on Thai purse seiners (to 16 crew members) could be promoted to Thai fishers and fishing operators involved in Thai purse seining in the near future. From the said sea trial, the number of crew and their positions required on the new improved and modified pilot Thai purse seiner, could be: one (1) Master Fisherman, one (1) Steer man, one (1) Engineer, four (4) Able Seamen, two (2) Divers, and seven (7) Seamen. Therefore, the total number of crew members required onboard is only 16 persons.

Furthermore, TD also implemented the Departmental Program "**Improvement of Fisheries Technology and Reduction of the Impact from Fishing**" with the objective of improving fishing technologies and marine engineering to mitigate the impacts of fishing activities on the fishery resources and marine ecosystem. The activities in 2019 included:

- Support to local agencies in Trat Province, Thailand in the implementation of the Project "Sustainable Development Strategy for the East Asia (SDS-SEA)" from 2019 to 2020

with the objective of formulating coastal fisheries management plan and strengthening community management in Trat Province;
- Support to the DOF of Thailand in the investigation of the design and construction of sergestid push net fishing gear;
- Support to the "National Working Group to Consider the Marking of Fishing Gear in Thailand" in its effort of initiating the conduct of research study on marking of fishing gear in Thailand;
- Development of proposal and tool to study the types and amount of debris in the surface layer of Chao Phraya River that flow into the Gulf of Thailand; and
- Development of map of marine debris collected by bottom trawling during the conduct of fisheries resources survey in the Gulf of Thailand (August-November 2018) and the marine debris survey (December 2019) (*see 6.1 Extending support and capacity for Member Countries on fishery resources survey*).

Discussion on Ecosystem-based Approach to Fisheries Management (EAFM) in Trat Province

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

1.6.1 Integration of habitat and fisheries management

With integration of habitat and fisheries management towards conservation of important marine fishery resources in the backdrop, TD implemented the Project "**Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia**" since 2015. The Project was 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.

Way back in 2017, TD had conducted a survey on the design and construction of Fish Enhancing Devices (FEDs) by small-scale fishers in the Gulf of Thailand, and later in 2018, a survey was conducted along the coast of the Andaman Sea. Such surveys were meant to identify the different designs and construction factors of FEDs suitable for different localities and fishing grounds. Based on the results of the surveys, TD came up in 2019 with the compiled information on the designs, materials used and construction of FEDs, and maps of important fishing grounds and habitats in Thailand where FEDs had been installed. Such reports had been used as reference by the AMSs in selecting and applying the different designs of FEDs as appropriate. In this connection, TD collaborated with the Faculty of

Marine Technology of Burapha University (Chanthaburi Campus) in Thailand to undertake the study "Environmental and Socio-economic Impact of the FEDs in Coastal Area of Trat Province Thailand" in 2019, mainly aimed at obtaining the understanding of the impact of FEDs using rope as alternative materials, on the ecosystem and socio-economic aspects of fishing communities.

Meanwhile through the Project, TD carried out the "Study on Enhancement of Sustainable Management of the Blue Swimming Crab Fisheries" in pilot sites in Kep Province, Cambodia starting in 2017. Upon the identification of the fishing grounds of blue swimming crab in Kep Province, knowledge transfer and capacity building were provided to local fishers and local fisheries officers from Kep Province, specifically on rehabilitation methodologies. This led to the promotion of the crab bank management scheme and hatchery techniques that aimed to enhance the crab resources, as well as the demarcation of the conservation area in Angkaol Village in Kep Province, which was marked with buoys through the cooperation and participation among the fishers and local officers of the Kep Fisheries Administration Cantonment (FiAC), and the Fisheries Administration (FiA) of Cambodia.

While the activities in Kep Province were continued, a study trip was organized on 6-12 October 2019 for researchers from the FiA and FiAC, and fishers from Cambodia to exchange information on the technical aspects and to enhance the capacity and awareness of researchers and fishers from Cambodia on crab fishery resources rehabilitation in sea grass fishing grounds. The study team visited four (4) fishing villages in Thailand, namely: 1) Tong Tom Yai Village in Chumphon Province, 2) Phru Jood Village in Trang Province, 3) Lampho Community in Chai Ya District, Surat Thani Province, and 4) Pak Nam Pran Village in Prachuap Khiri Khan Province, to learn the blue swimming crab fishery resource management measures undertaken in different areas in Thailand. The study team also had the opportunity to exchange relevant information with fishers in Thailand on local crab bank systems and resource management initiatives. Through this study trip, the fishers from Angkaol Village were able to directly obtain information on the measures for blue swimming crab conservation and management system in Thailand, which they could transfer to Kep Province toward the sustainable utilization of the blue swimming crab resources in the future. Based on the results of the activities undertaken in Kep Province, the "Report on the Study on Enhancement of Sustainable Management of the Blue Swimming Crab Fisheries in Kep" was produced by TD for dissemination to the SEAFDEC Member Countries.

In concluding the activity, TD organized the "Regional Workshop on Fisheries Resource Enhancement and Habitat Conservation Measures in Southeast Asia" on 9-12 December 2019 in Kep Province, Cambodia, where the results of the study were disseminated to local stakeholders from Koh Kong, Sihanoukville, Kampot, and Kep Provinces of Cambodia. The Workshop was able to initiate the exchange of information and experiences on resource enhancement activities with the stakeholders from the other AMSs.

Participants of the Regional Workshop on Fisheries Resource Enhancement and Habitat Conservation Measures in Southeast Asia (9-12 December 2019, Kep Province, Cambodia)

Achievements: Fisheries resources enhancement measures in critical habitats/fishing grounds
In responding to the "Policy Recommendations and Strategic Plans of Action for the Implementation of Fisheries Resources Enhancement Activities in the Southeast Asia Region" adopted by the AMSs in 2015, SEAFDEC formulated various fisheries resource enhancement measures and interventions that have now been promoted and implemented in various pilot sites that include the following: In Kep Province of Cambodia for the study "Establishment of hatchery facility (crab bank) for conservation of blue swimming crab" In Krabi Province of Thailand on the "Development of conservation and management measures for dog conch shell resources" In 15 provinces along the coastal areas of Thailand on the "Compilation of information on designs, materials and construction of FEDs and mapping of important fishing grounds and habitats with suitable FEDs installations" The "Application of EAFM using co-management and participatory approach for local fishers, local fisheries administration, and central fisheries administration in resources enhancement and fisheries management" in project sites, namely Aung Kan Thar Village, Thahton Township, Mon State of Myanmar (2017); Trapeang Ropov, Kampot and Prey Nup 2, Preah Sihanouk Provinces of Cambodia (2018); and Pak Kadang, Bolikhamsai Province of Lao PDR (2019) Based on the implementation of the resource enhancement measures and interventions, the Southeast Asian countries would soon be provided with the guidelines for investigating the environmental and socio-economic impacts from such interventions on the resources, which had been developed for publication and subsequent dissemination to the region.

Furthermore, 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**" which was initiated in 2016 with support from 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 for safeguarding the habitats critical to the life cycles of important fishery resources as this would not only improve and secure marine biodiversity but also build resilience for those who rely on the oceans for their food and livelihoods. This initiative is expected to provide multiple benefits for the marine ecosystem and the people, considering that in the course of the project implementation, the ministries and agencies responsible for fisheries and the environment are encouraged to work closely with all stakeholders concerned and link fishing effort with coastal management practices.

The Project has 4 components:

1) Identification and management of fisheries and critical habitat linkages at priority fisheries *refugia* in the South China Sea;
2) Improving the management of critical habitats for fish stocks of transboundary significance via national and regional actions to strengthen the enabling environment and knowledge-base for fisheries *refugia* management in the South China Sea;
3) Information management and dissemination in support of national and regional-level implementation of the fisheries *refugia* concept in the South China Sea; and
4) National cooperation and coordination for integrated fish stock and critical habitat management in the South China Sea.

The achievements made under each component in 2019 are summarized as follows:

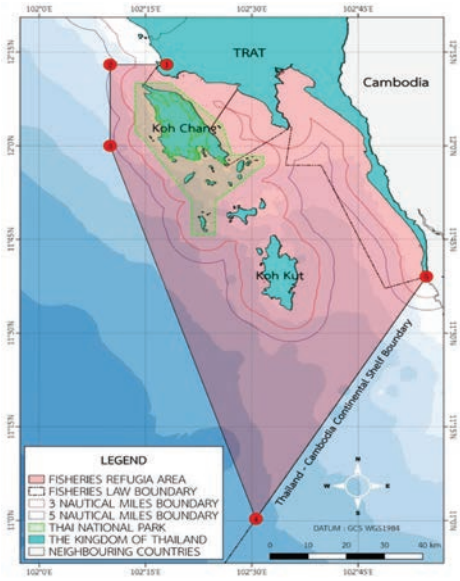
Component 1:

- Signing of Letters of Agreement (LOA) by Viet Nam and Indonesia for the implementation of activities starting in May and June 2019, respectively, and presently, all six project participating countries have already signed the LOA for this Project
- Initiation of fisheries and coastal habitat information and data collection from 15 priority fisheries *refugia* sites
- Organization of intensive series of consultation on the boundaries of fisheries *refugia*, which have been supported by facilitated processes, to identify key threats to the fisheries *refugia* sites and to initiate discussion on possible management measures for evaluation
- Conduct of governance reviews, stakeholder analyses, socio-economic information and data collation, and reviews of existing management arrangements had been initiated in 12/15 sites
- Training of national teams on project management and governance arrangements

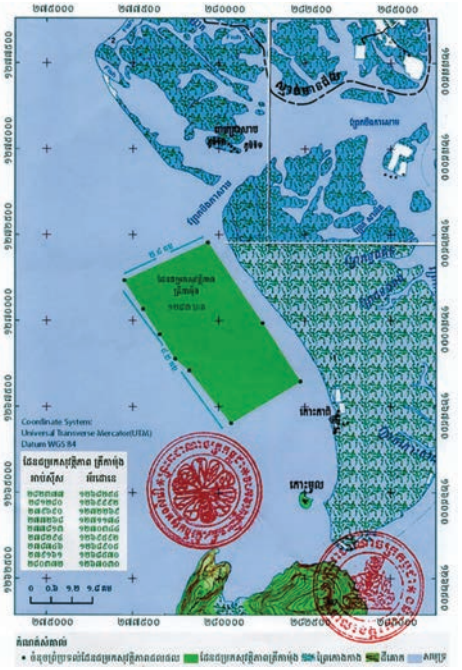
Fifteen priority fisheries refugia *sites identified in six participating countries*

Component 2:

- Review of working documents for regional level, on key threats from fishing and the environment to fish stocks and critical habitat linkages at the priority sites in the participating countries
- Compilation and review of existing regulations and by-laws in 12/15 sites at which the project is presently working, with feedback provided to national teams, to aid in the formulation of recommendations on policy and legal reforms to support the promotion of responsible fishing at times and at locations critical to fish stocks and critical habitat linkages
- Conduct of workshops with local stakeholders and officials on policy and legal aspects of *refugia* (terminology, procedures, recommended reforms) in the participating countries enabled more realistic discussions that reflects local stakeholder needs, expectations, and concerns on socio-economic impacts of the management
- Preparation of questionnaire survey templates to: 1) compile and update information and data on distribution of habitats, known spawning areas, locations of *refugia*, MPAs, fisheries management areas, and critical habitats for endangered species; and 2) produce detailed site characterizations for the 15 priority fisheries *refugia* sites for incorporation into national and regional datasets
- Preparation of draft Terms of Reference for the development of fish early life history information which is meant to improve regional understanding of fish early life history and links to critical habitats, while discussion on the draft with regional universities, and internationally recognized institutions with expertise in this field, had been initiated
- Endorsement by the Minister of Agriculture, Forestry and Fisheries (MAFF) of Cambodia, of the Proclamation of the Establishment of Management Area of Mackerel Fisheries *Refugia* in Koh Kong, and Blue Swimming Crab Fisheries *Refugia* in Kep, Cambodia



Draft demarcation area (GIS Map) for establishment of short mackerel fisheries refugia *in Trat Province, Thailand*



Proclamation of the Establishment of Management Area of Mackerel Fisheries Refugia *in Koh Kong adopted by MAFF, Cambodia*

Component 3:

- Development and publicizing of regional website "fisheries-*refugia*.org" with newly developed short films and journal articles written by regional project staff, as well as social media platforms including YouTube and Facebook, while a six-part short film social media campaign which is under preparation, would be uploaded soon
- Development of "national fisheries-*refugia* web portals" in local language by the respective participating countries
- Conduct of the "Regional Meeting on Indicators for *Refugia* Management" on 9-11 September 2019 in Chonburi Province, Thailand, where standardized methods for collection and analysis of information and data on *refugia* effectiveness (including indicator system) were discussed and these would be included into one regional paper to guide countries in establishment and management of fisheries *refugia* for long-term sustainability
- Conduct of the "Regional Consultative Meeting on Management of Transboundary Species: Short Mackerel" on 12-13 September 2019 in Chonburi Province, Thailand, in collaboration with the SEAFDEC-Sweden Project, which came up with the draft "Regional Action Plan for Management of Indo-Pacific Mackerel in the Gulf of Thailand Sub-Region," the extent of which could also cover the South China Sea Sub-region, and which the drafted RAP-Indo-Pacific Mackerel was noted by the 42nd PCM, and will be subsequently submitted to the 52nd Meeting of the SEAFDEC Council Meeting for endorsement and consideration for endorsement by the ASEAN

Component 4:

- Agreement on the detailed terms of reference for site-based management boards of 15 priority fisheries *refugia* sites were under progress
- Conduct of the "2nd Meeting of Regional Scientific and Technical Committee (RSTC2)" on 21- 23 May 2019 in Kampot Province Cambodia, which promoted regional cooperation in the integration of scientific knowledge and research outputs with management, as the RSTC2 discussed the management of transboundary species and other management tools to support the establishment of fisheries *refugia* by countries with updated progress of works at the national and regional levels
- Conduct of the 2nd Meeting of Regional Project Steering Committee (PSC2)" on 5-6 November 2019 in Sarawak, Malaysia which sought the consideration and endorsement of the progress of works at the national and regional levels, including the draft Indicators for Management of Fisheries *Refugia*, draft RAP-Indo-Pacific mackerel, Ocean Modelling, and regional workplan on best practices of fisheries gears and methods, while the PSC2 also noted the knowledge attitudes and practices to be applied during the implementation

2nd Meeting of Regional Scientific and Technical Committee (21-23 May 2019, Kampot Province, Cambodia)

2nd Meeting of Regional Project Steering Committee (5-6 November 2019, Sarawak, Malaysia)

1.6.2 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 prompting FAO to develop and impose the International Plan of Action for the Conservation and Management of Sharks in 1998, and submit the 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). In 2003, some species of sharks were listed for the first time, in Appendix II of CITES during the 12th Meeting of the Conference of the Parties to CITES (CITES-CoP12). Specifically, from 2003 to 2016, twelve 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*), while all species of manta rays (*Manta* spp.) and devil rays (*Mobula* spp.) have been listed in Appendix II of CITES, and seven species of sawfishes (*Pristidae* ssp.) have already been listed in Appendix I of CITES. During the recently-organized CITES-CoP18 in 2019, additional species were also listed in the Appendix II of CITES, namely: ten species of wedgefish (Rhinidae), six species of guitar fish under Genus (*Glaucostegus* spp.), and two species of mako sharks (*Isurus oxyrinchus* and *I. paucus*). It has therefore become crucial 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, and through coordinated efforts of 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.

From 2013 to 2019, MFRDMD had implemented the Project "**Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region**" 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 utilization of sharks and rays in the region for proper and sustainable fishery management. The Project had Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam as the participating countries. Results from the implementation of this Project had been reported in earlier publications.

During the course of the Project implementation, MFRDMD had been conducting data collection of sharks and rays from various landing sites in the AMSs. Results from the data collection carried out by MFRDMD in 2019 in Larut Matang (Perak), Kota Kinabalu, and Tawau (Sabah), revealed 11 species of sharks from four (4) families and 21 species of rays from six (6) families recorded in Perak; 21 species of sharks from eight (8) families and 24 species of rays from nine (9) families were recorded in Kota Kinabalu, while five (5) species of sharks from three (3) families and 14 species of rays from six (6) families were recorded in Tawau.

Furthermore, the most abundant shark species in Larut Matang (Perak) were *Chiloscyllium hasseltii, Chiloscyllium punctatum, Carcharhinus sorrah, Atelomycterus marmoratus* and *Sphyrna lewini*; and for rays were *Neotrygon orientalis, Maculabatis gerrardi, Maculabatis pastinacoides, Brevitrygon heterura* and *Rhynchobatus australiae*. In Kota Kinabalu, the

most abundant were *Chiloscyllium punctatum*, followed by *Chiloscyllium plagiosum*, *Atelomycterus marmoratus, Carcharhinus sorrah,* and *Sphyrna lewini*; while for rays *Neotrygon orientalis* was most abundant followed by *Telatrygon zugei, Maculabatis gerrardi, Brevitrygon heterura,* and *Rhinobatos* cf *jimbarensis*. As for Tawau, the most abundant shark species were *Sphyrna lewini* and *Carcharhinus sorrah*. Other shark species such as *Carcharhinus leucas, Carcharhinus melanopterus,* and *Chiloscyllium plagiosum* were only landed in 1-2 months. The most common and abundant ray species, landed throughout the year, were *Neotrygon orientalis, Teanura lymma, Maculabatis gerrardi, Gymnura zonura* and *Rhynchobatus australiae*. Other ray species *Aetobatus ocellatus, Himantura leoparda, Himantura uarnak, Himantura undulata, Myliobatis hamlyni, Pateobatis jenkinsii, Rhina ancylostoma, Rhinoptera javanica* and *Rhinoptera jayakari* were landed in 1-3 months.

In terms of the composition of sharks and rays landings compared to the total marine landings, in Larut Matang the composition of sharks and rays was 0.4 % and 1.0 %, respectively. In Kota Kinabalu, the composition was 0.3 % and 0.9 %, respectively, and it was 0.7 % and 2.7 %, respectively, in Tawau.

In addition to species identification using taxonomic characteristics, genetic data (DNA barcode) was also used to identify the shark and ray species. From a total of 138 shark, 259 ray and 20 skate specimens that had been sequenced for DNA barcoding, the results indicated 39 species of sharks, 50 rays and five skates. About 80% of these data has been uploaded to BOLD database system. Moreover, a visit to nearby Kalimantan in Indonesia was organized by MFRDMD on 1-16 September 2019 for the marketing and socio-economic studies of sharks and rays.

In sustaining the capacity building activities on the taxonomy of sharks and rays, MFRDMD conducted the "Regional Training and Workshop on Chondrichthyan Taxonomy, Biology and Data Collection" on 16-20 June 2019 at the premises of MFRDMD in Terengganu, Malaysia. With 35 trained personnel in the taxonomy of sharks and rays from the AMSs (except Brunei Darussalam, Lao PDR, and Singapore), the Training made sure that the participants were able to identify common species of sharks and rays found in their respective countries, as well as manage the landing data recorded at landing sites in their countries.

Participants of the Regional Training and Workshop on Chondrichthyan Taxonomy, Biology and Data Collection (16-20 June 2019, Kuala Terengganu, Malaysia) (left) *and during the practical activity* (right) *as part of the Regional Training*

As a supplementary to the aforementioned Project, TD also carried out from 2013 to 2019 the Sub-project "**Data collection of the commercially-exploited aquatic and threaten**

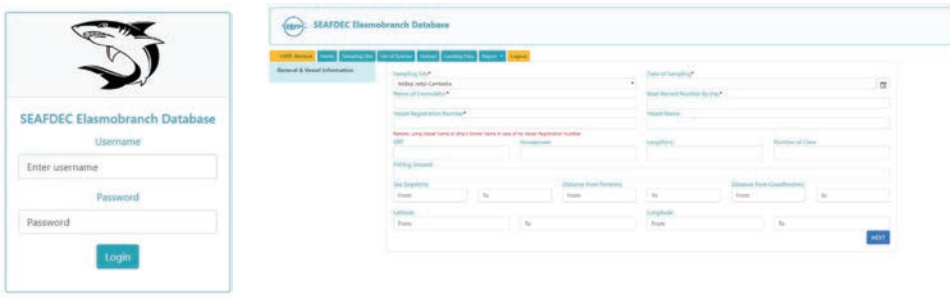
species" under the project "**Enhancing the Compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region.**" This Sub-project was aimed at: 1) Enhancing the capability of the Member Countries in compiling and utilizing 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.

While sustaining the capacity building on data collection of sharks and rays, and in response to the recommendations made during the 2018 Training on Yield Per Recruit (YPR) model, TD organized in 2019 the "Regional Training Course on Age Determination using Vertebra of Sharks and Rays" from 29 April to 1 May at its premises in Samut Prakan, Thailand. At this training course, participants from AMSs were trained on the proper collection of vertebrae from sharks, staining, operating the vertebrae cutting machines, and counting yearly rings of the vertebrae. The participants also learned how to use the software application for counting the yearly rings, back calculation of age, and estimation of the growth parameter. Results from age determination using the vertebra of sharks and rays would be very useful in attaining more reliable results from the YPR model.

Regional Training Course on Age Determination using Vertebra for Sharks and Rays (29 April - 1 May 2019)

Moreover, data collection of sharks and rays in Southeast Asian countries were undertaken in three pilot landing sites, *i.e.* in Tawau, Malaysia during October-December 2019 which would be continued until September 2020; Songkhla Province, Thailand and in Cilacap, Indonesia during July 2019-December 2019 which would be continued until June 2020. With the data collected from these pilot landing sites, the National Reports of Sharks and Rays Data Collection would be published, which could be used as reference for policy makers to support the development of the respective countries' NPOA-Sharks in the future.

Another related on-going activity in 2019 was the development of data management platform for sharks and rays. The "SEAFDEC Regional Sharks and Rays Database" which was developed since 2013 to store and share data on sharks and rays collected through various projects of SEAFDEC as well as by the respective countries, was sustained until 2019. The Database would also be useful in facilitating the collection and utilization of available data for the development of NPOA-Sharks by the respective countries.



SEAFDEC Regional Sharks and Rays Database

Further to the efforts of collecting data on sharks and rays, the SEAFDEC Secretariat also implemented since September 2018 the one-year "**SEAFDEC-EU/CITES Sharks Project Phase II**" in collaboration with TD and MFRDMD with a view to supporting 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. To make sure that all countries in the region would be able to develop robust NDFs in the future, the project facilitated the establishment of the best practice examples for the region by assisting countries that have comprehensive data sets and information on catch of CITES-listed shark species in developing the NDFs. Simultaneously for those that have no or limited information available, the project supported their primary collection of the needed data. Thus in 2018, focus was given to capacity building for enumerators in countries with insufficient information (*i.e.* Myanmar, Cambodia and Viet Nam), which enabled the enumerators to improve the collection of data on sharks and rays at landing sites. After the completion of the one-year data collection, SEAFDEC conducted the "One-Year Shark Data Collection Validation Workshop" on 8-9 October 2019 in Bangkok, Thailand. Attended by the respective project National Focal Points and two local enumerators from Cambodia and Myanmar who had been involved in the data collection, and resource persons from SEAFDEC who had supported the validation of the collected data and initial analysis, the Workshop identified the constraints that contributed to the difficulties in continuing with the data validation, and came up with recommendations to address the concerns. As a result, the countries agreed to continue their efforts in improving their systems of data collection on sharks landing in the future by recording at species level.

Participants of the One-Year Shark Data Collection Validation Workshop (8-9 October 2019, Bangkok, Thailand)

Meanwhile, considering that the Philippines had insufficient compilation of information and data on sharks and rays which is necessary for developing the NDFs, even if the country has long-term series of catch landings of sharks and rays but which have not been classified by species, a "Training on Taxonomic Identification based on SEAFDEC Data Collection Protocol for Sharks and Rays" was organized for the staff and field enumerators of BFAR Regional Office-VI and the National Fisheries Research and Development Institute (NFRDI) of the Philippines on 15-17 January 2019 in Iloilo City, Philippines. The Training made sure that future data on sharks and rays should be reported not only in terms of volume of catch but also classified by species. In addition, the Training facilitated the compilation of biological information as well as the catch and effort data of sharks and rays, which are necessary to determine the stock status of certain targeted shark and ray species, as these would serve as necessary inputs for the development of the country's NDF for CITES-listed sharks and rays species in the future.

Participants of the Training on Taxonomic Identification based on SEAFDEC Data Collection Protocol for Sharks and Rays (15-17 January 2019, Iloilo City, Philippines)

Participants being coached on the proper identification of sharks species during the Training in Iloilo City

For the other participating countries that had more comprehensive data sets and information, series of "National Workshop on CITES Listed Non-Detriment Finding Document" were organized, *i.e.* for Thailand on 18-19 July 2019 in Samut Prakan, for Malaysia on 6-7 August 2019 in Tawau, and for Indonesia on 18 September 2019 in Jakarta. The workshops were aimed at supporting information exchange and development of NDFs, and raising the awareness and building the capacity of CITES competent national authorities, *i.e.* the Scientific and Management Authorities, and other key stakeholders of the respective countries, on the development of NDFs. Experiences and lessons learned from the experts not only from SEAFDEC but also from the national authorities in terms of developing NDFs, were discussed during the workshops, the results of which were disseminated to the participating countries.

Achievements: Data collection on sharks and rays in the Southeast Asian region
The several projects implemented by MFRDMD, TD, and the SEAFDEC Secretariat on sharks and rays data collection, led to the following achievements: • The AMSs were able to build their respective capacities in the identification of sharks and rays at species level, as well as in the collection of the data on sharks and rays on systematical manner, leading to the reporting of sharks and rays data at species level by six (6) participating countries, namely: Cambodia, Indonesia, Malaysia, Myanmar, Thailand, and Vietnam. • The data collected during certain periods (*e.g.* 2015-2016) using appropriate models had been analyzed, the use of the Yield Per Recruit (YPR) model which was found suitable to assess the stock and fishery status of sharks and rays was promoted in the Southeast Asian region, and researchers from the AMSs gained on-hand experience on the application of the YPR model. • The AMSs were able to build their respective capacities in utilizing sharks and rays data compiled, in the development of their respective NPOA-Sharks, as well as NDFs for sharks and rays.

1.6.3 Conservation and management of catadromous eels

Catadromous eels (*Anguilla* spp.) have been considered as one of the most important commercial aquatic species because of their nutritional value and preference especially in the East Asian countries. With the rapid decline of temperate eel species stocks that led to the listing of some Anguillid eel species in the CITES Appendices, *e.g. Anguilla anguilla*, the market value of tropical eels has risen during the recent years leading to the dramatic intensification of glass eel capture fisheries in tropical areas including many Southeast Asian countries. The rapid decline of glass eel catch in temperate areas, posed risks for the possible listing of these eel species in the CITES appendices in the future. Some countries in the region have imposed regulations to avoid overexploitation of the tropical eel species by regulating the size and prohibiting/limiting the export of glass eels from. However, information, such as the actual catch of eels in Southeast Asia, eel stocks, and biological characteristics, remains minimal to support the management toward sustainable utilization of the species.

To address the concerns on the sustainability of the anguillid eel resources in the Southeast Asian region, SEAFDEC continued to implement in 2019, 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**" was implemented by IFRDMD in collaboration with AQD and the SEAFDEC Secretariat. Started in 2015 and completed in 2019, the Project was aimed at: 1) obtaining clear understanding on the current situation of resources, fisheries, and utilization of catadromous eels in the region; 2) improving data collection and statistics of catadromous eel catch in the AMSs; and 3) enhancing knowledge and capacity in the AMSs for the conservation, management and sustainable utilization of catadromous eel resources.

In an effort to obtain clear understanding on the present status of resources, fisheries and utilization of catadromous eels, IFRDMD conducted baseline studies on eel fisheries, *i.e.* data and information on eel fisheries, status on utilization of eel resources, and culture

production of tropical catadromous eels. These studies were carried out in some AMSs where catadromous eel fisheries are practiced, namely: Cambodia, Indonesia, Myanmar, Philippines, Thailand, and Viet Nam. Although only few countries could provide their national statistical data on tropical anguillid eels, the series of baseline data available from Myanmar, Indonesia, Philippines and Viet Nam, was therefore utilized for the initial analysis of the status and trends of harvesting the tropical anguillid eels in these countries.

Collecting glass eels using scoop net

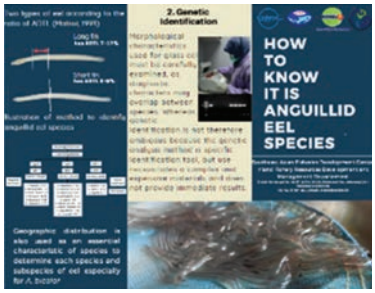
Glass eels

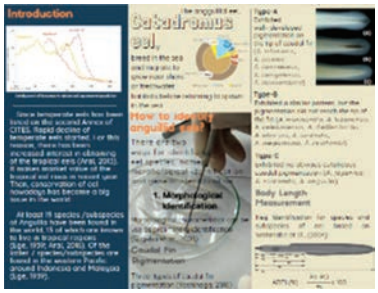
Nonetheless, only few countries have continued to establish their complete national statistical data collection systems on harvesting and farming of the tropical catadromous eels. As a result, eel statistics are no longer available in many AMSs at present, like Myanmar and Viet Nam. IFRDMD therefore focused its activities on the establishment of data collection systems for these two countries.

With regard to the need to enhance the knowledge and capacity of the AMSs in the conservation, management and sustainable utilization of catadromous eel resources, IFRDMD viewed that information on the geographical distribution of eel species in the respective AMSs is necessary for the promotion of eel biodiversity conservation and sustainable management of eel populations. Therefore, using the genetic data from 5' region of the mtDNA D-loop region, IFRDMD was able to analyze the species diversity of tropical eels in Indonesia, Philippines, and Viet Nam. As a result, five species and subspecies of glass eel were identified in the samples from Indonesia, *i.e. Anguilla bicolor bicolor, A. bicolor pacifica, A. marmorota, A. bengalensis, A. interioris* and *A. luzonensis*; three species in the samples from the Philippines, namely: *A. bicolor pacifica, A. marmorota,* and *A. luzonensis*; four species in the samples from Viet Nam; and one species in the samples from Myanmar, *i.e. A. bicolor bicolor*. Comparing the results from this present study with those of the previous study, it could be deduced that more variety of species could be identified from genetic study using D-loop region of mtDNA marker. However, the results of the present study also provided the essential information for future studies of tropical anguillid eel species that could contribute to the development of strategies for the management of these eel species in the future.

As for resource enhancement of anguillid eels, preliminary results from the study conducted in Indonesia by IFRDMD revealed upward migration of eels in the hydropower dam (PLTA Poso II) which is equipped with fish ladder. The "PLTA Poso II" is located in Poso River and operated by the company "PT. Poso Energy." In 2019, this company undertook a precautionary approach to maintain the sustainability of anguillid eels in Poso Lake by restocking eels at Peura Village in Poso Lake and at the mouth of Poso River.

On information dissemination, IFRDMD produced a leaflet on the method of identifying tropical anguillid eel species based on their morphological characteristics. Launched in October 2019 during the "Workshop on 5-year of IFRDMD's Achievement," the leaflet was provided to fishers at the field. In addition, a comic book "Anguillid Eel: The Tough Fish" was also published to disseminate the information on the biology of anguillid eels, eel fishing activities, and the importance of habitat conservation for the sustainability of eel resources. This comic book, which was also launched in October 2019 and originally written in English, had been translated into Vietnamese, Filipino, Thai, Indonesian, and Myanmar languages. Furthermore, results of studies undertaken by IFRDMD on anguillid eels, were also presented during the "Workshop on 5-year of IFRDMD's Achievement" as well as other national and international conferences.





A leaflet for identifying tropical anguillid eel species by morphological characteristics was distributed to fishers in the field

Comic book on the sustainable use of eel resource

Comic book translated into 5 languages: three translations of the comic book into the Indonesian, Myanmar, and Vietnamese languages are shown above

The second Project "**Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia**," which was implemented by the SEAFDEC Secretariat in collaboration with IFRDMD and AQD, was supported by the Japan-ASEAN Integration Fund (JAIF). The Project was aimed at strengthening and consolidating eel resource management framework for sustainable provision of eel products and eel capture fisheries/eel farming in the AMSs. Through this Project, SEAFDEC organized two back-to-back workshops on "Statistics of Tropical Anguillid Eels in Southeast Asia" and "Aquaculture of Tropical Anguillid Eels in Southeast Asia" in Manila, Philippines on 23 April 2019 and 24-25 April 2019, respectively. The discussions during the workshops focused on the status of the tropical anguillid eel resource utilization, distribution and resource

stock of tropical anguillid eels in the Southeast Asian countries, and the development of technologies to improve the survival rate of juvenile eels. During the workshops, AQD launched its Aquaculture Extension Manual No. 65 "Nursery Culture of Tropical Anguillid Eels in the Philippines," and disseminated to the workshop participants.

Participants of the Workshop on Statistics of Tropical Anguillid Eels in Southeast Asia (23 April 2019, Manila, Philippines)

Participants of the Workshop on Aquaculture of Tropical Anguillid Eels in Southeast Asia (24-25 April 2019, Manila, Philippines)

Aquaculture Extension Manual "Nursery Culture of Tropical Anguillid Eels in the Philippines"

SEAFDEC also conducted the "3rd Regional Meeting on Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia" on 22-23 July 2019 in Bangkok, Thailand, to present and evaluate the final results of the activities conducted under the JAIF-supported project and to finalize the draft Project Report. The final report, also known as the "Information Paper," was submitted to the 30th Meeting of the Animals Committee of CITES in 2018. In 2019, the Information Paper was reviewed and updated for submission to the 31st Meeting of the Animals Committee scheduled in 2020. Subsequent to the 3rd Regional Meeting, SEAFDEC finalized and published the JAIF Project Report "Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia" which summarized the final results of the Project.

Participants of the 3rd Regional Meeting on Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia (22-23 July 2019, Bangkok, Thailand)

JAIF Project Report "Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia"

Taking into consideration the required actions to be undertaken on Anguillid eels that were raised during the 18th Session of the Conference of the Parties to CITES (16-28 August 2019, Geneva, Switzerland), SEAFDEC organized the "Regional Core Experts Meeting on Tropical Anguillid Eel Information Sharing" on 3-4 October 2019 in Samut Prakan, Thailand. The Meeting discussed the areas where improvements could be made on the "Information Paper," *e.g.* modifying the report structure, making use of more updated data based on the JAIF Project Report, and preparing a shorter version of the Information Paper with more engaging and easy to read contents. Furthermore, the Meeting also recommended for the refinement of the future JAIF Project on eels "**Development of Stock Assessment Method and Strengthening of Resources Management Measures on Tropical Anguillid Eels in ASEAN Region**" which the SEAFDEC Secretariat had started securing the necessary funding from JAIF for one-year implementation starting in 2020.

Regional Core Experts Meeting on Tropical Anguillid Eel Information Sharing (3-4 October 2019, Samut Prakan, Thailand)

Considered as a continuation of the first eel project supported by JAIF, the new Project has the overall objectives of collecting catch data and biological/ecological information for the estimation of eel resources stocks, and developing mathematical/statistical methods for estimating the stocks of tropical anguillid eel resources to be used in formulating effective management measures for the sustainable utilization of tropical anguillid eels in Southeast Asia.

1.6.4 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 of the status of important neritic tuna resources in the region. In 2016-2017, stock assessment of longtail tuna (*Thunnus tonggol*) and kawakawa (*Euthynnus affinis*) was carried out, the results of which were reported to the 50th Meeting of the SEAFDEC Council and the 25th Meeting of ASWGFi in 2017. Subsequently in 2018-2019, the stock assessment activity was expanded to cover the Indo-Pacific king mackerel (*Scomberomorus guttatus*) and narrow-barred Spanish mackerel (*Scomberomorus commerson*).

In 2019, SEAFDEC conducted the "5th Meeting of the SWG for Stock Assessment on Neritic Tunas in the Southeast Asian Region" on 9-11 January 2019 in Bangkok, Thailand. The Meeting was intended to update the results of the stock and risk assessment of Indo-Pacific king mackerel and narrow-barred Spanish mackerel using the softwares on CPUE standardization, *e.g.* ASPIC, Kobe plot, Risk Assessment, and review and discuss the status of seer fish stock, risk assessment, and corresponding workplan. The Meeting also reviewed the results of the genetic study on longtail tuna and kawakawa, and discussed the capacity building requirements to improve the neritic tuna statistics of the Southeast Asia countries.

Participants of the 5th Meeting of the SWG for Stock Assessment on Neritic Tunas in the Southeast Asian Region (9-11 January 2019, Bangkok, Thailand)

Achievements: Sustainable utilization of neritic tunas in the ASEAN region
The "Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region (RPOA-Neritic Tunas)" which was developed and approved by the SEAFDEC Council during its 47th Meeting in 2015, and by the ASEAN through the 17th Meeting of the ASWGFi and the subsequent SOM-AMAF in 2015, had been used by the AMSs as basis for the development of projects on neritic tunas in their respective countries. The "Scientific Working Group on Stock Assessment for Neritic Tunas in the Southeast Asian waters (SWG-Neritic Tunas)," which was established under the RPOA-Neritic Tunas, had been providing technical/scientific advice particularly on the current status of neritic tuna fishery resources and policy consideration needs, to the SEAFDEC Council of Directors for the improvement of neritic tuna fisheries management in Southeast Asia.

The stock and risk assessment of neritic tunas species carried out from 2014 to 2019 for longtail tuna, kawakawa, Indo-Pacific king mackerel, and narrow-barred Spanish mackerel, using ASPIC and Kobe plots, as well as the genetic study of longtail tuna which was also carried out covering the South China Sea, Gulf of Thailand and Andaman Sea, came up with the following results:

- **Longtail tuna**: Generally, the species had been seriously overfished, and subjected to overfishing in the Indian Ocean (2014), although the stock appeared to be in very safe situation in the Pacific Ocean (2013)
- **Kawakawa**: The species was in safe situation in the Indian Ocean (2014) as well as in the Pacific Ocean (2013)
- **Narrow-barred Spanish mackerel**: Although the species appeared in the green zone, it was considered to be still not in a safe situation because of the high percentage of uncertainties, *i.e.* 73%, in the Indian Ocean (2016), while the species had been very seriously overfished and subject to overfishing in the Pacific Ocean (2016)
- **Indo-Pacific king mackerel**: The species appeared to be in very safe situation in the Indian Ocean (2016), as well as in the Pacific Ocean (2016)

Under the RPOA-Neritic Tuna Framework, SEAFDEC in collaboration with Brunei Darussalam had scheduled to organize the "Practical Workshop on Stock Risk Assessment of Longtail Tuna and Kawakawa in the Southeast Asian Waters" in February 2020. The Workshop would aim to conduct a second stock assessment for longtail tuna and kawakawa, and update and analyze the data on these two species that had been compiled from the respective AMSs.

1.6.5 Conservation and management of Indo-Pacific mackerel

Indo-Pacific mackerel is another important species that are transboundary resources and shared by many countries in the Southeast Asian region, and series of activities had been carried out on the species with support from the SEAFDEC-Sweden Project during 2016-2019 with particular focus in the Gulf of Thailand Sub-region. Implemented with the collaboration of concerned countries, *i.e.* Cambodia, Malaysia, Thailand, and Viet Nam, the activities included gathering of data and information on Indo-Pacific mackerel from the concerned countries and conduct of DNA study to obtain better understanding of the status, genetic structure, and population necesary to come up with appropriate management measures for the concerned countries.

In addition, under SEAFDEC/UNEP/GEF Fisheries *Refugia* Project, Indo-Pacific mackerel was also identified as one of the priority species by many of the Project's participating countries, namely: Cambodia, Thailand, and Viet Nam. The *refugia* site for Indo-Pacific mackerel in Cambodia was identified in Koh Kong, and information on the species was gathered by the Fisheries Administration of Cambodia, *i.e.* morphology and distribution, life cycle and mating behavior, length at first maturity /size/weight/age, gonadosomatic index and size frequency, area of habitat in each stage/migration pattern, and the importance of the *refugia* site to the life cycle of the species as nursery/spawning/feed. For Thailand, the selected *refugia* site was in Trat Province, and the Department of Fisheries (DOF) of Thailand compiled the information and data derived from abundance surveys, size-frequency surveys, fish eggs and larvae samples collected from Trat waters, and landing data in Trat Province. For Viet Nam, Phu Quoc was identified as priority *refugia* site for

Indo-Pacific mackerel. Furthermore, series of consultations were also conducted to seek agreement on maps of short mackerel fisheries *refugia* sites, assess the environmental and social impacts of designating certain sites as *refugia*, and identify the key threats to the sites and management measures.

During the "Technical Meeting on Management of Transboundary Species: Indo-Pacific Mackerel in the Gulf of Thailand" in December 2018, the Meeting provided recommendation for development of joint management plan for Indo-Pacific mackerels in the Gulf of Thailand Sub-region. As a follow-up and with co-financial support from the SEAFDEC-Sweden Project and the SEAFDEC/UNEP/GEF Fisheries *Refugia* Project, the "Technical Consultative Meeting on Drafting of the Regional Action Plan for Management of Transboundary Species: Indo-Pacific Mackerel (*Rastrelliger brachysoma*) in the Gulf of Thailand Sub-region" was organized on 12-13 September 2019 in Chonburi Province, Thailand. The Meeting came up with the draft "Regional Action Plan for Management of Transboundary Species: Indo-Pacific Mackerel in the Gulf of Thailand Sub-region." Aimed to achieve "sustainable Indo-pacific mackerel fisheries in the Gulf of Thailand Sub-region by 2030 through a holistic management approach," the Regional Action Plan comprises five (5) dimensions, namely: 1) ecosystem, 2) social, 3) economic, 4) governance, and 5) climate change, and was presented to the 42nd PCM in November 2019 in Chiang Mai, Thailand and endorsed for further submission to the 52nd Meeting of the SEAFDEC Council scheduled in 2020 for consideration and support.

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 implemented the project "**Human Resources Development (HRD) for Sustainable Fisheries**" from 2014 until 2019. The Project was meant to strengthen the knowledge and skills of key national officers of the AMSs in dealing with every aspects of sustainable fisheries development, with special focus on improving the incomes and well-being of fishers by introducing methods that are suitable and applicable for adding value to their fish catch.

In 2019, the implementation of this project focused at new pilot learning site in Pak Kradeng, Bolicumsei, Lao PDR, with a view to improving the incomes of fishers through responsible and sustainable fisheries activities. At the onset, TD organized the "Workshop on Key Stakeholders' Engagement and Investigate the Real and Current Situation Which Led to Low Income of Fishers in the Project Site in Lao PDR" on 5-7 March 2019. The Workshop discussed and sought the agreement on the project activities, project site, and groups of key stakeholders at the site to be involved in the project.

Based on the results of the discussion, TD organized the "Training Workshop on Development of Workplan for Improvement of Fishers' Income for Lao PDR" on 22-26 April 2019 in Phetchaburi, Thailand. At this Training Workshop, the participants had the opportunity to visit and observe the activities in Thailand related to the improvement of fishers' income through responsible fisheries and value adding of fisheries products.

Workshop on key stakeholders' engagement and investigating the real and current situation which lead to the low income of the fishers in the project site in Lao PDR (5-7 March 2019)

Training workshop on development of workplan for improvement of fishers' income for Lao PDR (22-26 April 2019)

The Training Workshop also discussed and came up with the draft EAFM Plan, focusing on the ways and means of increasing the incomes of fishers through responsible fisheries and other alternative livelihood activities. Subsequently, TD organized the "Training/Workshop to Revisit/Finalize the Existing Fisheries Management Plan for Pak Kading, Bolikhamsai Province, Lao PDR" on 26-30 August 2019, where the fisheries management plan of the project site was discussed and finalized, and the Workshop came up with the final EAFM Plan for Aung Kradeng, Bolicumsei, Lao PDR. The TD staff visited the site again on 23-27 September 2019 to follow-up and evaluate the implementation of activities based on the agreed EAFM Plan, and concluded the results and lessons learned from applying the EAFM concept in the real situation at Pak Kradang, Bolicumsai, Lao PDR. TD staff visit to the site was organized again on 23-27 December 2019 to follow up on the results of the application of the EAFM concept at the project site.

Workshop to finalize and formalize of the fisheries management plan (26-30 August 2019)

Regional Workshop on Lessons Learned from Application of EAFM in Different Learning Sites (7-8 October 2019)

During the last year of the project implementation, TD conducted the "Regional Workshop on Lessons Learned from Application of Ecosystem Approach to Fisheries Management (EAFM) in Different Learning Sites" on 7-8 October 2019 in Bangkok, Thailand. The Workshop came up with a compilation of the lessons learned in the implementation/ application of the EAFM concept in different pilot learning sites, and the ways forward in applying/implementing EAFM in the Southeast Asian region.

Achievements: Human resources development for sustainable fisheries

Through the project "**Human Resources Development (HRD) for Sustainable Fisheries**," the AMSs continued to obtain knowledge on the application of the EAFM concept through the series of regional and national training courses on sustainable fisheries offered by TD.

The trained officers of the AMSs are now able to apply the knowledge and skills acquired through the past training courses organized by TD, as well as through the implementation of activities at pilot learning sites.

EAFM Core Teams, comprising officers that have good understanding and experiences in formulating/implementing the EAFM concept, have been established in the respective participating countries and are now able to serve as the key persons for expanding the development and implementation of the EAFM Plan in their respective countries. Through the EAFM Core Teams, series of activities had been carried out in four identified pilot learning sites in the AMSs: 1) Aung Kan Tha, Mon State, Myanmar; 2) Prek Thnot Commune, Teok Chhou District, Kampot Province; 3) Aung Kradang, Bolicumsei, Lao PDR; and 4) Ban Nai Nang, Krabi Province, Thailand.

Furthermore, series of training sessions on essential-EAFM had been conducted by TD since 2014, by making use of the training materials developed by the United States National Oceanic and Atmospheric Administration (NOAA). In 2019, NOAA again supported TD by conducting series of writeshops/workshops on 11-15 February 2019 and 3-7 June 2019, to revise the training materials, particularly the PowerPoint presentations on e-EAFM, incorporating the experiences from the pilot implementation of the EAFM throughout the past years. Subsequently, by making use of the revised materials, two training sessions were organized, the first of which targeted the BFAR officers on 9-13 September 2019 in Iloilo, Philippines, and the second for fisheries officers of FiA Cambodia on 16-20 December 2019 in Phnom Penh, Cambodia.

Parallel with the abovementioned project, TD under its national activities also supported the DOF of Thailand in enhancing the understanding of DOF officers and promoting the application of EAFM concept in Thailand. Several training courses and workshops on EAFM were therefore organized, such as the "Ecosystem Approach to Fisheries Management (EAFM) Training Course" from 26 February to 2 March 2019 in Nakhon Ratchasima Province, which was participated by 25 fishery managers and fishery extension officers of the DOF of Thailand. The Training Course promoted the concept and principles of EAFM and facilitated the development of fishery management plan meant to address the problems/issues, settle conflicts, and encourage the participation of fishery stakeholders. This was followed by the "Workshop on Key Stakeholders' Engagement, Problem Identification and Fisheries Management Plan Development" on 15-17 May 2019 in Krabi Province, which was attended by fishery officers and key fisheries stakeholders from the Province. The Workshop provided capacity building to participants on the application of EAFM by encouraging the key stakeholders to participate in fisheries management, and came up with the EAFM plan for Ban Nai Nang, Krabi Province. In addition, TD conducted the "Ecosystem Approach to Fisheries Management (EAFM) Training Course" on 27-31 May 2019 in Chiang Mai Province, which was participated by fisheries officers from the DOF of Thailand.

EAFM Training Course (26 February - 2 March 2019, Nakhon Ratchasima Province, Thailand)

Workshop on key stakeholders' engagement, problem identification and fisheries management plan development (15-17 May 2019, Krabi Province, Thailand)

Specifically, in one of the EAFM pilot learning sites in Ban Nai Nang, Krabi Province of Thailand, TD also organized a study visit and observation program on 5-9 August 2019 to provide the participants with ideas on alternative livelihoods that could increase the incomes of the community. The study visit, which was participated by provincial fisheries officers from Krabi Province and community members from Ban Nai Nang, observed the activities of the women's group in making local dessert in Phetchaburi Province, fish processing in Nakhon Sawan Province, and honeybee culture at a private farm and the Agricultural Technology Promotion Center in Chiang Mai Province. Subsequent to the study visit, the EAFM Plan for Ban Nai Nang which was developed through a Workshop in May 2019, was discussed again among the EAFM Core Team and stakeholders, and finalized for submission to the Provincial Fisheries Office of Krabi Province. Then TD organized an event to "Finalize and Formalize the EAFM Fisheries Management Plan for the Ban Nai Nang Community Krabi Province" on 14-15 August 2019 in Krabi Province, Thailand, which was participated by the key stakeholders in the village. Noting that the ecosystem approach to capture fisheries management has now been accepted worldwide, the stakeholders agreed on the final EAFM Plan and developed a more detailed workplan for submission to the DOF of Thailand.

EAFM Training Course (27-31 May 2019, Chiang Mai Province, Thailand)

Study visit and observation program provided the stakeholders with initial idea to increase the incomes for Ban Nai Nang community (5-9 August 2019)

Tailor-made Training Programs

TD also provided support to the human resources development of the AMSs through its "**Tailor-made Training Programs**," where training could be designed and conducted based on the specific requirements of requesting agencies and countries. In 2019, the tailor-made training programs conducted by TD include:

1) Training Course on Basic Principles of Fishing Gear (13-22 March 2019 at TD in Samut Prakan, Thailand) to build the capacity of 23 fisheries officers from the DOF of Thailand on the basic principles of fishing gear taking into consideration the fishing situation in Thailand
2) 62nd Short-term Training Course for University Students on Ecosystem Approach to Fisheries Management (EAFM) (4-14 June 2019 at TD in Samut Prakan, Thailand) to provide knowledge to and raise the awareness of 26 students from five universities in Thailand (*i.e.* Kasetsart University, Burapha University (Bangsan Campus), Burapha University (Chantaburi Campus), Prince of Songkla University and Chulalongkorn University) and one university in Japan (Hokkaido University), on responsible fishing for sustainable fisheries and on the EAFM concept

Training Course on Basic Principles of Fishing Gear (13-22 March 2019, Samut Prakan, Thailand)

Sixty-second Short-term Training Course for University Students on Ecosystem Approach to Fisheries Management (EAFM) (4-14 June 2019, Samut Prakan, Thailand)

3) Tailor-made Training on Inland Fish Culture in Thailand (5-12 August 2019, supported by the World Bank Project-Tamil Nadu Irrigated Agriculture Modernization Project (TN-IAMP)) to build the capacity and develop the skills of 13 fishery officers from the State of Tamil Nadu, India on inland fish culture through visits to culture facilities, such as the Inland Aquaculture Research Institute in Bang Sai, Ayutthaya Province, and private breeding and hatchery farms in Pathum Thani Province, Thailand
4) Tailor-Made Training on the Application of Coastal Ecosystem Approach to Fisheries Management (EAFM)-Learning Site in Krabi Province, Thailand (19-24 August 2019, supported by Industrial Development Unit, PTC/ENV/IRE United Nations Industrial Development Organization) to enhance the understanding and gain experiences on the application of EAFM concept for ten trainees from Sudan through visits to the EAFM learning site in Krabi Province as well as through the observation of the activities of the ecological and alternative livelihood groups such as honeybee culture, eco-tourism, and fish processing by the women's group in Krabi Province

Tailor-made Training on Inland Fish Culture in Thailand for officers from the State of Tamil Nadu, India (5-12 August 2019)

Tailor-Made Training on Application of Coastal EAFM-learning site in Krabi Province, Thailand for trainees from Sudan (19-24 August 2019)

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

While monitoring and addressing the continuous occurrences of emerging diseases, serious issues on fish health management need to be persistently controlled as this hinders the wholesome development of aquaculture. With funding support from the Japanese Trust Fund (JTF), AQD addresses this growing concern through the development of rapid and effective fish health management strategies.

Artificial infection experiments using different weight ranges of *P. vannamei* were conducted for White Spot Syndrome Virus (WSSV) and Acute Hepatopancreatic Necrosis Disease (AHPND) to determine the threshold levels of infection which can eventually cause mortality in shrimps. While the threshold infection levels of WSSV in shrimps using different weight ranges had been determined at 10^7 to 10^8 DNA copies/g, time-course experiment for AHPND was carried out using three (3) body weights of shrimps (average body weight or ABW=3-5 g, 15-18 g, and 20 g and above), wherein the standard curve for the real-time PCR had been established. This information together with optimized protocols could be used to detect the target pathogens, serving as reference in the monitoring and diagnostic schemes at the farms and enabling the farmers and stakeholders to strictly monitor the health status of their aquatic animals affected by the aforementioned diseases. Thus, early and effective intervention strategies could be undertaken at the farm level.

Enhancement of the efficacy of vaccine treatment in tropical cultured species of fish and shrimps

In preventing the incidence of viral nervous necrosis (VNN) in high-value marine fishes, the field efficacy of the formalin-inactivated nervous necrosis virus (NNV) was evaluated in pompano. Intramuscular injection of a sublethal dose of NNV in pompano juveniles (MBW: 4.7±1.7 g) resulted in 0-15% mortality rate. The surviving fishes were re-challenged with

a lethal dose of NNV at 1 and 2 months post-primary sublethal NNV injection, and the results indicated that none of the fish died nor manifested any VNN associated symptoms. However, 70-80% mortality rates were observed in the control fish groups suggesting that in natural NNV infection, upregulation and subsequent proliferation of anti-NNV neutralizing antibodies play an important role in suppressing or controlling the progression of the disease.

The use of adjuvants, carriers, and RNAi technology for enhancing the antiviral immune response of shrimp to WSSV was examined to determine if the efficacy of combined recombinant proteins, rVP28 and dsRNA, as antiviral treatment against WSSV is effective. In tank trials, oral delivery using microparticles to encapsulate the proteins at 1:3 ratios is most effective in reducing mortalities caused by WSSV infection. Although low-cost delivery and improved efficacy are needed in enhancing the resistance of shrimp by the application of immune-stimulating or virus-inhibiting compounds in shrimp culture, this result could only be adopted by farmers when the study has already been verified under actual field conditions.

Trichodina *sp.*

On the development of measures against persistent and emerging parasitic disease on tropical fish, a study was conducted to test the efficacy of orally administered garlic (*Allium sativum*) extract against *Trichodina* sp. in Nile Tilapia. Results showed that tilapia fed with garlic extract supplemented diets showed reduction in prevalence and intensity in *Trichodina* sp. compared to the control. *In vitro* results showed that the time required to eradicate *Trichodina* sp. was 45 minutes at 150 ppm, and 10 minutes at 400 ppm. Histopathology of the gills indicated that the control tilapia revealed hyperplasia and lamellar fusion which did not occur in the tilapia fed with the garlic diet. The results therefore demonstrated the potential of powdered garlic as a natural alternative to chemical treatments for eliminating parasites in tropical fishes. This also clarified the factors associated with the susceptibility or resistance of fish to some parasitic infection as well as established the disease transmission cycle which can be used to formulate the practical strategies for preventing parasite infestation in the future.

On the development of protective measures against VP_{AHPND}, one of the causative agents of the early mortality syndrome (EMS), it was previously observed that exposure of shrimp to 35°C temperature and 10 and 28 ppt salinities could result in mortalities. However, using greenwater stocked with siganid for not less than two weeks provides protection against the disease and also improves shrimp growth and survival. Comparing the survival among shrimps with high and low VP_{AHPND} infection maintained in aged seawater, the results showed low survival in shrimps with high infection. Among shrimps with low VP_{AHPND} infection, higher survival was observed when the shrimps were maintained in seawater aged for 14-28 days (70% and 63%, respectively) compared to those maintained in seawater aged for 7 days (48%), and non-aged seawater (39%).

Aside from the scientific solutions to the concerns on emerging diseases and aquatic animal health management, effective dissemination of useful information should also be promoted considering that the global market has become more stringent for exporting countries, more particularly from the Southeast Asian region. Thus, it has become

necessary to share knowledge and transfer technologies to the ASEAN Member States (AMSs), especially within their respective local government units, aquaculture farmers, traders, and other stakeholders. The capability of fish health personnel from the AMSs was therefore boosted through an on-site training on health management of freshwater fish. Organized by AQD in Myanmar on 16-21 December 2019, the training had 15 participants who were trained on major bacterial and parasitic diseases. Lectures focusing on these topics enabled the fish health personnel to stay abreast of the latest issues on persistent and emerging transboundary diseases. The training course was formatted in such as way that theoretical knowledge is imparted and skills enhanced through hands-on exercises. At the end of the training, the participants were capacitated with the necessary knowledge and skills for the accurate diagnosis of bacterial and parasitic diseases.

Participants in the training on health management of freshwater fish in Myanmar

2.2 Establish and promote responsible management of natural resources

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

While aquaculture is rapidly growing in the region, it has also brought negative impacts such as degradation of culture sites, destruction of sensitive organisms, decrease in biodiversity, spread of diseases, and even social conflicts. Environmental and social issues continue to arise from aquaculture practices which may threaten food security and poverty alleviation. With support from the JTF, AQD has been exerting efforts to establish and promote technologies that are more environment-friendly. One such effort is the development of nature-conscious culture technologies, such as the use agricultural wastes and by-products (ABPs) as feed ingredients to produce tilapia with improved traits. The previous tilapia feed formulation was therefore refined to include other low-cost feed ingredients (*e.g.* poultry by-product meal). Indoor feeding trials of tilapia fingerlings were conducted to test six diet formulations, containing fermented (bacteria- and *Trichoderma*-treated) and non-fermented okara meal, which were compared to a fishmeal-based (FM) diet. The three best performing diets were selected based on improved growth performance of tilapia fingerlings for further testing in tank- and lake-based cage conditions.

Okara meal

Moreover, the promotion of responsible aquaculture through aquasilviculture was also pursued, where aquasilviculture is the integration of aquaculture with mangroves providing bioavailable food and nutrients for organisms in all tiers of the food web as well as improving the water quality in ponds. Comparing the culture water quality and shrimp performance in aquasilviculture ponds (mixed and separate) and ponds with mangroves, the results showed higher shrimp survival in separate (47%) and mixed (39%) aquasilviculture ponds, compared to a non-aquasilviculture pond (0%). As for WSSV load, this was higher in the non-aquasilviculture pond (10^{11} copies/g) compared with that of the aquasilviculture ponds (10^{6} copies/g). Water quality was also better in aquasilviculture ponds since they had lower temperature, salinity, and ammonia levels.

The promotion of community-based production and resource enhancement was carried out to protect aquatic resources in the wild, secure the livelihoods of the communities in order that fishers would not engage in illegal fishing activities, and reduce social conflicts. The Community-Based Resource Enhancement (CBRE) Project of AQD in Molocaboc Island, Sagay in central Philippines aspires to maintain the marine ecosystem in the community through community-based production of high value but threatened aquatic resources through stock enhancement. Using hatchery-reared abalone and sandfish juveniles produced in aquaculture facilities, strategies had been developed comprising a series and combination of social activities and exploratory release of juveniles. Social preparation strategies such as establishing collaboration among fisherfolk, local government and researchers were undertaken including the organization of the fisherfolk into what is now known as the Molocaboc Sea Ranchers Association (MOSRA) which has been officially registered with the Philippine Department of Labor and Employment. MOSRA spearheaded the bottom-up promulgation of the first-ever abalone catch size regulation at >6 cm, and the eventual release of 11 batches of hatchery-reared abalone from 2011 to 2015 in a coralline area 2 km from a residential shoreline. Participatory monthly monitoring of catch showed that catch of abalone continued to increase. Since 2015, after the last batch of abalone seeding, the catch per unit effort (CPUE) of abalone continued to increase at an average of >150 individuals per hour dive of three divers. Meanwhile, releases of sandfish started much later in 2015 but there were already observable increases in growth and density, although its recovery was challenged by societal problems.

The major impacts of the CBRE Project include the rebuilding of resources in overfished areas through releases of hatchery-reared juveniles, while the community-based and tri-party collaboration are enhanced to implement and manage the resource-enhanced sites. The solar-powered hatchery and nursery units for abalone and sandfish provide the assurance of the sustainability of the CBRE Project because the juveniles can now be produced locally and on small-scale basis. Regulations in abalone and sandfish harvesting had been established by the community, allowing only the harvest of abalone with >6 cm shell length and sandfish at 320 g live weight. Fishers in the area were not only provided income-generating livelihoods through harvesting but have been capacitated in aquaculture operations to enable them to become better stewards of the fisheries and the environment.

Capacity enhancement lectures empower the local fishers in Molocaboc Island, Philippines

Seahorse juveniles produced in a backyard hatchery

Resource enhancement of seahorses was also carried out in Molocaboc Island, with trials on nursery rearing using natural food available in the local area as well as training of fishers in the community for seahorse culture. From those trials, the average number of seahorses increased at 33 per sampling from 30 per sampling in previous years. Community-based backyard hatchery of seahorse was also built in the community using solar-powered aerators and utilizing the available natural food such as copepods and mysid shrimps collected from the pilot site to feed the newborn and juvenile seahorses up to 4 months. Nursery rearing of juvenile seahorses was undertaken in submerged pens until the animals reached 7 cm stretched height.

Information, education, and communication campaign including lectures on seahorse biology and resource management were also conducted annually to increase the knowledge and appreciation of stakeholders on the importance of seahorses in the wild. Transfer of the latest technologies and information on aquaculture to the AMSs was undertaken through the training courses on *Marine Fish Hatchery* and *Rural Aquaculture*. The training on marine fish hatchery at AQD's Tigbauan Main Station, is a 37-day training that highlights on the breeding, hatchery seed production, nutrition and health management of grouper, sea bass, and snapper. The 2019 training was attended by eight participants of whom four were funded by the Government of Japan. On the 10-day rural aquaculture training sited at AQD's Binangonan Freshwater Station, focus was given on the promotion of community-based freshwater aquaculture for remote rural areas of Southeast Asia. This year's training had four participants all of whom were funded by the Government of Japan.

Information sharing within the scientific community

Sharing of knowledge within the scientific community was also pursued through the International Workshop on Promotion of Sustainable Aquaculture, Aquatic Animal Health and Resource Enhancement in Southeast Asia (SARSEA) 2019 organized in Iloilo City, Philippines on 25-27 June 2019. The Workshop aimed to update the participants, especially the concerned authorities, on the issues related to sustainable aquaculture, aquatic animal health, and resource enhancement; and to put forward recommendations to address the issues at hand. The Workshop enhanced the awareness of participants and strengthened their commitment to support research and development towards the

wholesome and responsible production of aquatic species. Nineteen (19) representatives from the SEAFDEC Member Countries reported on the status of sustainable aquaculture, resource enhancement, and aquatic animal health in their respective countries. Scientists and experts from AQD and other reputable institutions were also at hand to impart new knowledge in the field.

Participants of SARSEA 2019 in Iloilo City, Philippines, 25-27 June 2019

2.3 Improvement of broodstock and seed production technologies

Quality seed for sustainable aquaculture

Sustainable supply of good quality seedstock is key to a successful aquaculture enterprise. To achieve high farm yields, rearing quality seedstock to commercial sizes require efficient husbandry techniques and suitable farm conditions. Morever, the development and use of quality farmed broodstock and the adoption of optimal culture management methods are equally important in ensuring steady production of seeds and later, marketable aquaculture products. This is considering that in the AMSs, intensification of aquaculture systems and environmantal challenges especially those resulting from climate change, had escalated.

Broodstock development

In the development and management of quality broodstock for use in either commercial fish farming and/or stock re-population, information on (a) reproductive biology, (b) mating and breeding behavior, and (c) production of traits in traditional and emerging aquaculture species (*e.g.* catfish, silver therapon, abalone, tiger shrimp, grouper, and also polychaete as alternative natural food for these species), have supported the establishment of suitable broodstock management protocols. Nutritional intervention and improvement of reproductive traits of various aquaculture commodities have been sustained.

Catfish. Broodstock development and management of the Philippine native *Clariid* catfishes (mainly *Clarias macrocephalus* and *C. batrachus*) was continued, specifically by evaluating their reproductive traits for selection and propagation of quality broodstock. Offspring from the stocks collected in 2018 from Zambales, Philippines were reared and used for the stock evaluation. Other stocks collected later from Quezon and Iloilo Provinces would also be evaluated in terms of their breeding efficiency and response to broodstock test diets. The initial runs used the Zambales stock because offsprings from this batch have

been produced. To optimize the use of the Zambales F_1 stock which would be on-grown to mature sizes, some of the juveniles were initially set-up for a grow-out feeding experiment, using an invasive alien species, *e.g.* black mussel as feed attractant and as an additional source of crude protein. The feeding experiment tested three diets: (a) Diet—1 fish meal based diets as control; (b) Diet—2 okara-based diet; and (c) Diet—3 okara-based diet with 10% dried black mussel. Results of the feeding trial showed that the stocks fed with Diet 3 gave the highest specific growth rate (1.32±0.18%/day) while the lowest (0.92±0.18 %/day) was that of the stock fed the okara-based diet (Diet 2). This indicated the potential of black mussel as feed ingredient that could enhance the growth performance in native catfish.

Immediately thereafter, feeding trial on potential broodstock was conducted in lake-based cages using the Zambales F_1 stocks given three diets: (a) Diet 1 or basal diet with sardine fish meal, soybean meal, poultry by-product meal, wheat flour, rice bran, soybean oil, lecithin, vitamin premix, mineral premix, and vitamin C; (b) Diet 2 consisted of the same ingredients as diet 1 except for the inclusion of 0.5% paprika; (c) Diet 3 consisted of the same ingredients as diet 1 plus 0.5% black mussel; and (d) Diet 4 SEAFDEC formulated diet. Results after four months showed that the catfish responded best to the diet with 0.5% black mussel (Diet 3) in terms of weight gain (35.94 g) and to the SEAFDEC diet (Diet 4) in terms of survival (73.30%). These stocks would then be induced to spawn to determine the effect of these diets on their breeding efficiency.

Silver therapon. In the domestication of silver therapon (*Leiopotherapon plumbeus*), reproductive and nutritional performance were evaluated, specifically the effect of dried thraustochytrid biomass supplementation on the reproductive performance of three-year old broodstock of silver therapon in a tank-based feeding trial. Different treatment groups were examined: (a) Diet 1 - basal diet with 45% crude protein as control; (b) Diet 2 - basal diet with 0.25% dried thraustochytrid biomass; and (c) Diet 3 - basal diet with 0.5% dried thraustochytrid biomass. Hatchery-reared silver therapon broodstock (16.9-17.7 g) were stocked at 30 individuals per cage (1F:2M sex ratio) in three replicate suspended net cages (1 m length × 1 m width × 1.5 m depth) per treatment, and fed the diets for 14 weeks at 2% of biomass. The effect of dried thraustochytrid biomass supplementation on growth, survival, and reproductive performance (spawning success, fecundity, gonadosomatic index, fertilization and hatching rates) was examined. Results showed that female silver therapon broodstock fed 0.25% thraustochytrid biomass (Diet 2) and control diets (Diet 1) had higher spawning success than those fed 0.5% thraustochytrid biomass diet (Diet 3). Although the results did not show significant differences among the treatment groups, those fed the diet with 0.25% thraustochytrid biomass (Diet 2) had higher gonadosomatic index (GSI), fertilization, and hatching rates than those fed diet with 0.5% thraustochytrid biomass (Diet 3) and control diet (Diet 1). These suggest that supplementation of thraustochytrid biomass at 0.25% could enhance the reproductive performance of female silver therapon broodstock. Meanwhile, long-term feeding using diets supplemented with dried thraustochytrid biomass resulted in slight decline in growth performance, *e.g.* final body weight, percent weight gain and specific growth rate (SGR) of female silver therapon broodstock. Results however, showed no significant difference between the control and thraustochytrid-supplemented groups. Higher percentage weight gain and SGR were noted for the male silver therapon broodstock fed the diet with 0.25% thraustochytrid biomass than those fed 0.5% thraustochytrid biomass and the control

diets. Survival rates of female (93-97%) and male (92-100%) silver therapon broodstock were comparable among all the treatment groups.

Land-based cage set up for the silver therapon feeding trials

Feeding of silver therapon broodstock with diets containing dried thraustochytrid biomass

Abalone. The effectiveness of AQD-formulated broodstock diets in improving the reproductive performance and the quality of larvae in tropical abalone (*Haliotis asinina*) was evaluated, especially the two best performing diets: Diet 1 (37% protein /3570 kcal kg^{-1} energy) and Diet 2 (42% /3750 kcal kg^{-1}) administered to 960 hatchery-grown breeders, to determine whether further refinements are necessary or if the diets are ready for commercial application. The results showed that except for the mean number of spawning and female survival, the performance of female and male breeders from the different treatment groups was comparable. When some female breeders were given seaweeds as feed, the results indicated better performance in terms of frequency of spawning and survival rate than those fed the formulated feeds (Diet 1 and Diet 2). Fertilization, hatching and settling rates (10 and 20 days post-stocking) were likewise comparable in all treatments. However, settling rate after 30 days was higher in seaweed-fed abalones than those given Diet 1 but remains comparable with those given Diet 2.

Tiger shrimp. To understand the conditions that encourage and facilitate mating in tiger shrimps, mating behavior was observed at different depths and temperature levels. The video clips taken to observe the behavior of the shrimps indicated that molted females were pursued by males with the wild males spending more time near females than the captive males. Captive females appeared to molt longer than wild females in ambient temperature, where wild and captive stocks exit the molt or shell almost at the same time. There was no significant difference in the courtship behavior among the four trial combinations (wild female x wild male, wild female x captive male, captive female x wild male, and captive female x captive male) whether in the fluctuating ambient or in 32°C temperature levels for the 1.0 m water-depth experiments. However, there was significant difference in the courtship behavior of *P. monodon* among the three temperature levels in terms of the time spent by males near females, time spent by females near males, and time in seconds it takes for females to exit the molt.

Grouper. Giant groupers (*Epinephelus lanceolatus*) were studied to develop grouper breeding and seed production techniques. Giant grouper stocks at AQD were observed to directly undergo male sexual maturity from juvenile phase, and through sex change from functional females, as diandric protogynous hermaphrodites. Furthermore, females were noted to mature at an average of 23.5 kg body weight (BW) while males mature at around 17.5 kg BW compared to stocks in Viet Nam where females were observed to mature at

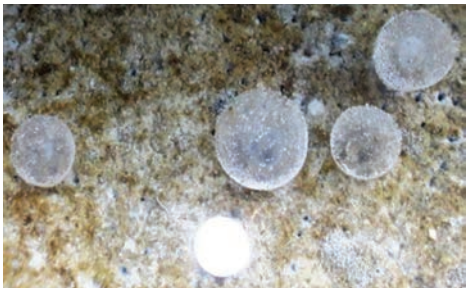
about 33.5 kg and males at 34.3 kg. At AQD, induced ovarian development was performed on the giant grouper juveniles through intramuscular injection and oral administration of FSH (follicle-stimulating hormone), which was possible only until the cortical alveolar stage, after which sex reversal would ensue. Spawning induction in giant groupers in the floating net cage was undertaken following the AQD protocols where slow-release gonadotropin-releasing hormone (GnRH) was implanted four days before full moon and then human chorionic gonadotropin (HCG) injection performed two days before full moon. Feeding trials in the grouper, using *Proales* sp. were conducted to improve survival during larval rearing. The inclusion of small rotifer during the first 10 days of rearing resulted in significantly higher survival rate in green grouper, tiger grouper, and giant grouper larvae. Two batches of giant grouper juveniles have been produced.

Development of cryopreservation protocol for grouper sperm at -80°C to prolong viability and fertilization capacity has been successfully demonstrated. Grouper sperm preservation protocol at 4°C was also developed applying storage conditions (osmolality, pH, sperm to diluent ratio) that were optimized. Successful hybridization between the giant and green groupers was achieved, where the hybrids which are known to have improved growth, and are most resistant to diseases. Plans to use sterile hybrids to apply surrogate technology in giant grouper production have been drawn.

Tiger grouper at AQD's marine fish hatchery

Polychaete. Production of nonconventional feed ingredients for diets of broodstocks has been pursued using the mudworm *Marphysa iloiloensis* (named after the Province of Iloilo) as an alternative natural food for crustacean broodstock as it contains 60-70% protein. The "clean" polychaetes or mudworm had been cultured in tanks at AQD following biosecure measures. Polychaetes spawned in broodstock tanks every month producing a total of 421 jelly cocoons. Good quality eggs were stocked in nursery tanks for 15 days and transferred to grow-out tanks for another 4.5 months producing a biomass of 331 ± 49 g/m², so that in a 13.8 m² culture area, a total of 4.91 kg polychaetes were harvested. About 2.12 kg polychaetes were supplied to AQD's Shrimp Hatchery for feeding experiments while the remaining polychaetes were used as broodstock. Different tank shapes were tested for the grow-out culture of polychaetes, and the results showed that survival, body weight, and biomass did not significantly differ among the different tank shapes with an area of 1.0 m² each ($p > 0.05$). However, in terms of growth, polychaetes cultured in basins (0.20 m²) had higher body weight (0.40 ± 0.02 g) than in 1.0 m² tank (0.18-0.28 g), which could be attributed to the low amount of feeds provided to polychaetes in 1.0 m² tanks at 20 g fish feeds/week while those cultured in basins (0.20 m²) were given 10 g fish feeds/week. Considering that the availability of feeds for polychaetes could be limited by the bigger culture area, additional feeds should be provided. Therefore, at a standard feeding rate of 10 g/0.20 m², 10 g feeds should be added for every additional 0.20 m² culture area. In a 1.0 m²

culture tank, 50 g of fish feeds should be provided once per week. In 2020, this study will focus on improving the survival and growth of polychaetes in grow-out culture using different feeding rates and feeding frequencies.



During spawning, eggs of polychaetes are deposited and fertilized inside this pear-shaped gelatinous mass (jelly cocoon) which emerges from the sediment with a stalk attached to the burrow entrance

Marphysa iloiloensis

Refinement of hatchery and nursery protocols

Various mechanisms to increase production and rearing of larval and juvenile stages of important aquaculture species (*e.g.* eel, mangrove crab, sandfish, pompano, milkfish, seaweeds) are being evaluated by AQD including the enhancement of laboratory production of natural food organisms and alternative food items (*e.g.* copepods) for early stage diets of the species. Improvement of rearing conditions and interventions that allow the aquatic organisms to adapt and survive well during larval development, has also been carried out.

Eel. Nursing of the Philippine native glass eels in captivity has been sustained, while the development of an appropriate rearing protocol for this fish species through the administration of suitable feeding schemes and formulated diets for nursing glass eels and young elvers had also been continued. Identification of anguillid eels based on morphological and genetic characterization and potential pathogens in nursery eel systems was also conducted.

In the assessment of pre-weaning diets for glass eels, *Tubifex* sp. or bloodworm gave better results than *Artemia nauplii* and artificial diets. In terms of diet form, moist paste diet gave high glass eel survival compared to those given dry and semi-moist diets. Moreover, 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 Aparri samples enabled the identification of 96 pcs of *Anguilla marmorata* among the stock, while four (4) were *A. luzonensis*. Samples from General Santos City (Mindanao) which were pre-sorted as *A. bicolor pacifica* based on visual examination, were validated as 100% *A. bicolor pacifica* based on cytB sequence alignments. Apart from mtDNA sequence analysis, seven microsatellite primers used in Anguillid species were successfully tried on the Philippine Anguillid eel samples, as the protocols for cross-amplification and microsatellite analysis were optimized. The glass eels and rearing water from the surveyed eel nursery farms were monitored for the presence of pathogens. Bacterial analysis of the water samples indicated presence of pathogens identified as ectoparasites (*Trichodina* spp.), monogeneans

(*Ichthyophthirius multifilis*), and bacteria (*Aeromonas* spp., *Pseudomonas* spp., and *Vibrio* spp.). Risk factors were noted and prevention, control and treatment measures have been recommended.

Elvers in a rearing tank

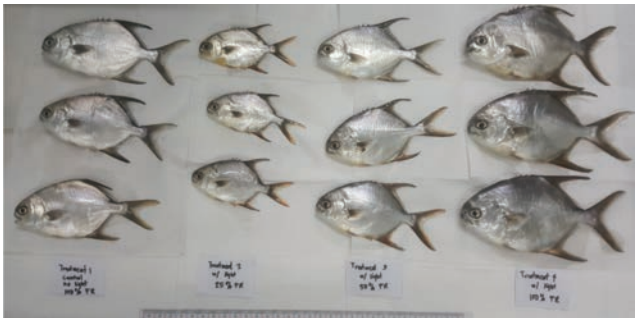
Mangrove crab. In the hatchery rearing of mangrove crab seedstock, live algae and algal paste (*e.g. Tetraselmis*-based) were evaluated as possible source of natural food for rotifers in the hatchery tanks. Generally, the highest count of rotifers was attained when crab larvae are fed live *Nanochlorum*. However, considering that mass production of *Nanochlorum* requires plenty of tanks and is prone to collapse during rainy season, alternative sources (*e.g. Tetraselmis* pastes) were evaluated to ensure steady supply of natural food for the rotifers. Results showed that the AQD *Tetraselmis* paste gave better results in terms of rotifers produced compared to live and commercially available *Tetraselmis* paste. On the second and fourth days of culture, the *Tetraselmis*-based algal paste produced by AQD gave significantly higher counts of rotifers than the live and the commercially available paste. Moreover, when the growth and survival of mangrove crab larvae given rotifers-fed algal paste were assessed, initially the lowest survival was observed in the crab larvae fed with rotifers that thrived on live *Tetraselmis* compared to the other treatments. However, the final survival of crab larvae from all treatments was not significantly different, suggesting that the *Tetraselmis* paste could be a good alternative to live algae.

Sea cucumber. In optimizing the protocol for hatchery production of early juvenile sandfish (*Holothuria scabra*), new broodstocks acquired from Concepcion in Iloilo, Sagay in Negros Occidental, and San Lorenzo and Igang in Guimaras, were used. From February to September in 2019, 16 spawning episodes were recorded which enabled the attainment of the target production of 20,000 early juveniles per batch. Moreover, two spawning episodes in February 2019 gave 20,000 and 23,000 juveniles respectively while a June spawning batch resulted to 51,000 juveniles. However, low survival of sandfish juveniles was noted due to fluctuating temperature, seasonally limited larval food, and low salinity during intense rain. In monitoring the apparent survival of larvae and settled juveniles, high mortality was found to occur during the first days of culture after the settlement plates were introduced in the tanks. Survival can be as high as 80% before the settlement plate introduction, but this is reduced to <12% after 7-10 days. Therefore, further research should focus on this critical phase to improve the overall survival.

Tank-based nursery system for sandfish was also carried out to determine (a) the optimal rearing conditions for primary nursery system for early juvenile sandfish in tank-based floating *hapa* nets, and (b) the rearing performance in the secondary nursery system for late juvenile sandfish in tank-based floating *hapa* nets. Survival of sandfish juveniles was

noted at 56% after one month rearing in *hapa* in tanks with 250 sandfish/*hapa* stocking rate where growth was recorded at about 0.02 g/day. For the second nursery phase, adoption of supplemental feeding was done using three feed types: Diet 1 - milkfish fry mash, Diet 2 - shrimp postlarvae feed, Diet 3 - *Sargassum* powder, and a control with no supplemental feeding. Three replicate bins with sediments were used for each treatment and control. Results after 30 days showed that sandfish fed milkfish fry feed (Diet 1) achieved the highest growth rate at 0.10g/d followed by shrimp postlarvae feed (Diet 2) at 0.05 g/d, but sandfish fed *Sargassum* powder (Diet 3) showed negative growth at -0.02g/d. The experiment is currently being replicated in outdoor tanks to examine the effects of the varying conditions.

Pompano. For the nursery culture of the snub-nose pompano *Trachinotus blochii*, artificial illumination was used in floating net cages to improve their growth and survival. Many studies have mentioned that the presence of light can attract sufficient quantities of wild zooplankton to satisfy the food requirements of aquatic animals as well as enable the animals to locate and efficiently prey on planktons. In investigating the effect of light on zooplankton abundance in the water as well as its effects on the growth and survival of pompano under different feeding regimes, these treatments were carried out: (a) 100% feeding ration and no light for control; (b) 25% feeding ration with light; (c) 50% feeding ration with light; and (d) 100% feeding ration with light. The results in the first trial showed that providing artificial light at night significantly improved the growth of pompano resulting in higher mean body weight in fry fed 100% of the total feeding rate. Values of water parameters were also observed to be within the optimum range. In another trial, treatments were the same but with the addition of another treatment using 75% feeding ration with light. Results showed that mean body and total lengths were still higher in fish fed 100% feeding ration with artificial light. Meanwhile, lower weight gain was observed in the second trial because of decreased water temperature from 31°C during the first trial to 29°C in the second. The survival rates in all treatments and both runs were similar. Data on ingested zooplankton showed that the most number of ingested preys was noted during 7 to 14 days of culture but decreased during the succeeding period. Pompano in lighted cages have high feeding incidence (86-100%) compared with those in the control or the unlighted cages (0-40%). High abundance of prey was observed in lighted cages compared with the control cages, where 90% of the total prey organisms in both lighted and unlighted cages were copepods. Considering the final growth with lower FCR, fish fed 75% of the feeding rate appeared to be the most cost-effective and can be recommended as an alternative rearing technique for the nursery culture of pompano.



Pompano harvest after 105 days of culture in first trial using four treatments

Pompano harvest after 105 days of culture in second trial using five treatments

Milkfish. The protocol for transporting milkfish juveniles (with an average total length of 5-6 inches) from the nursery to sea cage facilities was established by defining the optimal temperature and salinity requirements for the transport of milkfish juveniles, as well as the suitable conditioning period of confinement in cages in ponds before the juveniles are transported to milkfish sea cage farming sites. From the trials, results showed that milkfish juveniles (5-7 inches) can be transported for up to 12 hours in a closed system under various salinities, temperatures and their combinations, with minimal mortalities. The best result of the conditioning period of confinement prior to juvenile transport was 4 weeks while the least favorable was 1 day. As for the effect of 2 phenoxy-ethanol (PE) as sedative during actual juvenile transport, survival of the juveniles did not differ among the treatments while survival was comparable in treatments that have 2 fish/L, 4 fish/L, 4 fish/L plus 50 ppm of PE, and that of 6 fish/L plus 50 ppm of PE.

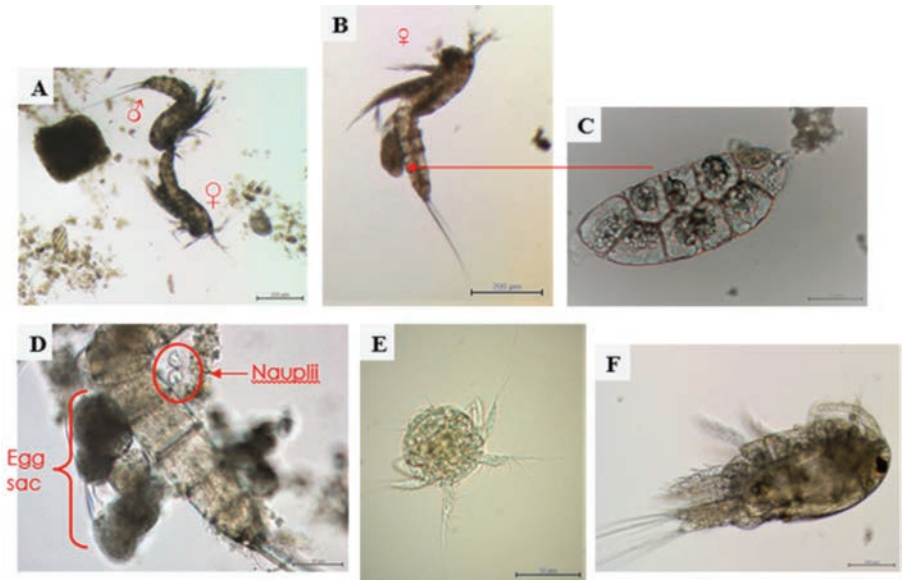
Seaweeds. In the production of *Kappaphycus* propagules in land-based nursery laboratory and sea-based nursery cages, the target production of 44 batches of seaweed propagules was achieved in 2019. These propagules were test planted in Pedada, Ajuy, a municipality in Iloilo Province, and the results showed that the plantlets achieved 8.7% growth rate per day. Clones of *Kappaphycus alvarezii* were also planted in Isabela City in Basilan and *K. striatus* in Panobolon Island in Guimaras to determine the quality of carrageenan extracted from farmed *Kappaphycus* grown using tissue-cultured seedlings. The results showed that carrageenan yield and gel strength in *K. striatus* were significantly higher than that in *K. alvarezii*. In the case of *K. alvarezii*, the growth of the tissue-cultured seedlings was also higher compared with the farmed-sourced seedlings in the grow-out. Continuous evaluation of tissue cultured seedling as a source of quality seed for seaweed farming was conducted. Carrageenan quality of the plantlets was determined by exposing the tissue-cultured *K. alvarezii* to different salinity levels (0, 5, 10, 15, 20, 25, 30, 35, and 40 ppt) and pH levels (pH 3, 4, 5, 6, 7, 8, and 9) for 7 days. Results showed variations in the carrageenan yield, viscosity, and gel strength of the thallus exposed to different salinities and pH, but the carrageenan yield was highest in the thallus that was exposed to freshwater for 24 hours. The survival rate in the sea-based nursery cages was almost 50% which is higher than that of the previous year (30%) due to continuous optimization of the nursery rearing techniques.

Test-planting of laboratory-produced Kappaphycus *propagules in Pedada, Ajuy in Iloilo, Philippines*

Natural food. In considering algal paste as alternative natural food source for hatchery and nursery rearing of aquaculture species, algal paste was produced through electrolytic flocculation using important, locally-available microalgal strains. Preliminary culture and scale-up of algae production were done for the diatom *Chaetoceros calcitrans*, where the growth curve showed a logarithmic phase from day 1 to 6 which then stabilized until day 9. The results suggest that *C. calcitrans* can be mass produced in 204 days and used for algal paste production. Upon assessment of the algal paste for its viability, length of storage, and for presence of metal residue, *e.g.* lead, the paste quality had some improvements as the lead content was reduced by 97% (from 1,318 ppm to 43.7 ppm) through manipulation of flocculator settings including voltage, anode, and cathode units. When feeding trials using the *C. calcitrans* paste was done on *Artemia salina*, the lead content in *Artemia*-fed rice bran with *C. calcitrans* paste (7.8±5.06 ppm) was significantly reduced (78%) compared with the lead content of *C. calcitrans* paste (34.27 ±0.39 ppm). Storage results after two weeks showed resuspension capacity for paste stored in an air-conditioned room and chiller, but the lag phase for paste stored in freezer was extended to four days. However, paste stored in the chiller and freezer after 1 to 3 months achieved higher densities compared to those stored in the air-conditioned room despite the extended lag phase, indicating the potential of algal paste produced by electrolytic flocculation and stored for as long as 3 months to be used as starter.

A modified continuous culture system was developed to efficiently mass produce *Nanochlorum* sp. that would eliminate the tedious scaling-up of algal culture and reduce the number of culture tanks. In the experimental runs that expose the *Nanochlorum* sp. to different pH levels, the first run included five pH levels (6.0, 6.5, 7.0, 7.5, and 8.5) with the normal seawater pH (7.9-8.1) and the control, where the pH of the control treatment was not adjusted, while the other pH levels were treated with either HCl or NaOH to attain the desired pH level. Results showed that the highest cell density at logarithmic phase was attained at pH 8.5, but was not significantly different among the treatments tested. In the second trial using eight pH levels (6.0, 6.5, 7.0, 7.5, control: 7.9, 8.1, 8.5, 8.0, and 9.0), the results showed significantly high cell density (1,023.9 ± 49.9 $x10^4$ cells ml^{-1}) at pH 8.0 and significantly low cell density (661.2 ± 16.7$x10^4$ cells ml^{-1}) at pH 6.0. In order to optimize the cost of culturing *Nanochlorum* sp., four culture media (Conwy, TMRL, Yashima & Commercial II) were tested with the culture maintained at pH 8.0. The results showed significantly high cell density of *Nanochlorum* sp. when cultured with Conwy medium (183.1 ± 13.9 $x10^4$ cells ml^{-1}) but was not significantly different in cultures enriched with TMRL medium (162.4 ± 13.7 $x10^4$ cells ml^{-1}).

Copepods. For sustainable production of harpacticoid copepods for marine fish and crustacean larviculture, the life cycle of the copepod *Tigriopus* sp. was investigated to determine and establish its optimal culture conditions for mass production. Compared to other copepod groups which are difficult to culture, the harpacticoid copepods have short generation period, high reproduction and population growth, are nonselective to diets, and can tolerate environmental fluctuations. This species, which could be used as live prey during the early stages of marine fishes and crustaceans, is therefore ideal for culture. In 2019, the life cycle of *Tigriopus* sp. was successfully monitored in culture tanks without aeration, showing that its life cycle takes about 6 to 7 days. During mating, the male *Tigriopus* sp. attaches its antennae to the posterior region of the female, and the ovigerous female can produce two pairs of egg sacs after a single mating. Each pair of egg sacs has 6 to 9 clutches (containing eggs) attached to the female body for 3 days where embryonic development takes place. Then, the egg sacs detach from the body and naupliar larval stage develops within 24 hours. After another 24 hours, the nauplii develops into copepodites. A new pair of egg sacs is immediately observed 24 hours after the first pair of egg sacs detaches from the female body. Experiments on salinity, temperature, and diet will be conducted in 2020. Mass production will also be done in larger tanks after the best rearing condition is determined. The copepod used in this study was identified as *Tigriopus* sp. based only on its morphological features, but DNA barcoding would still be necessary to confirm the species identification.



Morphology and development of Tigriopus *sp.: (A) Adult male clasping an adult female using its antennae (mate-guarding behavior); (B) ovigerous female; (C) egg sac; (D) egg sacs start to detach from the female; (E) nauplius stage; (F) copepodite stage*

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

Abalone. In the large-scale seed production of abalone, focus was made in increasing the juvenile yield to 5% by the application of interventions such as feeding, appropriate diatom strain, supplementation with microparticulate diet, and application of anesthetics for early harvest of juveniles. The effect of seaweed quality on broodstock and larval performance

was also evaluated while large-scale production of abalone using refined AQD methods was demonstrated. Improvement in target yield by 5% was achieved through increased diatom feeding. A total of 3,795,250 trocophore larvae were produced, out of which 47% (1,796,300 larvae) developed into veliger stage. The hatchery also produced a total of 61,137 early juveniles (3-8 mm shell length).

Settlement plates in tanks for abalone production at AQD hatchery

Mangrove crab. In the seed production of mangrove crab (*Scylla serrata*), 7.3 million newly-hatched larvae and 581,040 pieces of crablets were produced and sold to stakeholders. Average survival from zoea 1 to crab instar continued to increase where the highest survival rate of 10% was attained. This increase was reached after interventions in the hatchery rearing protocols were made which includes: reducing the frequency of antibiotic application, extending feeding frequency from 2 to 4 times a day at the megalopa to crab instar stages, increasing the frequency of water change from every 6 days to every 4 days, and providing additional shelters for the megalopa stage.

Achievements: Discovery of new species of soil-cleaning, broodstock-enhancing mudworm

The AMSs would benefit from the mass production technique being developed by AQD for the new species of mudworm, *Marphysa iloiloensis*, which has the ability to eat decomposed feed from culture ponds, lowering the levels of organic matter, sulfur, and iron in pond soil as well as reduce its acidity. Known as *Marphysa iloiloensis*, this mudworm species was named after Iloilo, the Philippine province that is host to AQD's facilities where the worm was collected. The collected eggs were initially encapsulated in jelly cocoons when they were collected from AQD's fishponds. It was after hatching the eggs and growing them to adult size that some mudworms were noted to be physiologically different from another known species. It was with the assistance of experts from the Museum and Art Gallery of Northern Territory in Australia that the specimens were confirmed to be a new species. The new species was listed in the World Register of Marine Species (WoRMS) database in September 2019.

The AMSs would also learn from the experiments of AQD on mudworms, which are being studied for their potential as food for crab and shrimp breeders. Several studies have shown that when used as feed, the mudworms could improve the reproductive performance of crustacean broodstock. AQD is currently developing a mass production technique for *M. iloiloensis* to lessen dependence on wild stocks and attain a disease-free and sustainable supply of mudworms for use in aquaculture. Once verified, the technique would be disseminated to the AMSs.

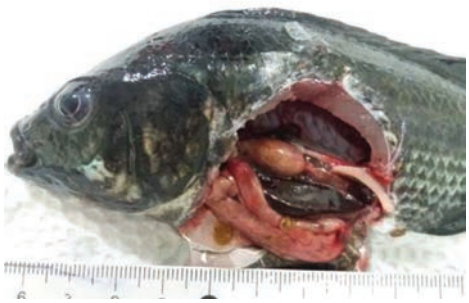
2.4 Ensuring food safety through sustainable aquaculture methods

Healthy and Wholesome Aquaculture

Innovations in fish health management and breakthroughs in feed nutrition are the approaches that could improve and sustain aquaculture production in order to withstand the escalating human population and the emergence of aquatic animal diseases. Practicing healthy and wholesome aquaculture is an integral part of the solution to the threats and challenges posed by ecological, economic, and climatic changes happening in the world today. In this regard, AQD continued to undertake projects on fish health, and nutrition and feed. While fish health projects concentrate on disease diagnosis, control, monitoring and surveillance of aquaculture commodities (*e.g.* tilapia, pompano, whiteleg shrimp, seaweeds) as well as on environmental integrity, certification, and food safety; the nutrition and feed projects focused on addressing the concerns and need areas in sustaining the production of aquaculture products in the region (*e.g.* pompano, tiger shrimp, Indian white prawn).

Fish Health Management Projects

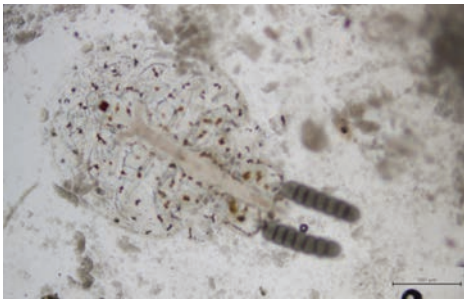
Tilapia. In detecting and quantifying the Tilapia Lake Virus (TiLV) in pond soil and water, the effects of environmental conditions in the proliferation and virulence of TiLV in tilapia and its natural environment had been elucidated. The 2,050 samples collected in May to December 2019 from the top tilapia (*Oreochromis niloticus*) producing provinces in the Philippines, namely: Laguna de Bay, Taal Lake, Calauan, Laguna, and Pampanga, consist of cultured (including fry, juvenile, and adult) and wild tilapia. Four weeks prior to sample collection, high mortalities were observed in floating cages at Taal Lake in Talisay, Batangas Province. From eleven diseased tilapia collected, the clinical signs included bilateral exophthalmia, hemorrhages, bloated abdomen, enlarged spleen, pale liver, degraded brain, and scale loss. Pathological changes were also observed, such as vacuolization of the brain, hemorrhages, and blood congestion among others. In one of the samples, a dual infection of *Streptococcus* spp. and TiLV was observed. However, no syncytial hepatitis or giant nucleated cells was observed in the sample which is the major clinical signs of TiLV infection in fish in terms of histopathology.



O. niloticus *(TL-Lau-H7-71119) sampled from a fish cage in Taal Lake in Talisay, Batangas showed pale liver and enlarged spleen, and with dual infection of* Streptococcus *spp. and TiLV*

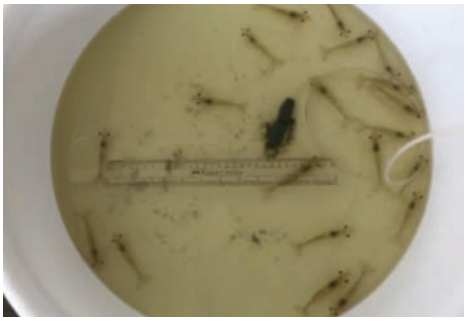
Pompano. In evaluating the efficacy and determining the effective dose of different chemotherapeutants (emamectin benzoate, hydrogen peroxide, and onion) against pre-adult and adult sea lice (*Caligus* sp.) in pompano under laboratory conditions, an experimental toxicity run was done to test the presence of hydrogen peroxide on snubnose

pompano (*T. blochii*). Results showed that the LC_{50} values were 3019.95, 3019.95, 1772.48 and 1363.69 ppm for 24, 48, 72 and 96 h, respectively. *Caligus* sp. were exposed to different concentrations (0, 25, 50, 100, 200, 400, 800 ppb) of emamectin benzoate (EMB). Preliminary results showed that 400 and 800 ppb of EMB were effective against the parasite. Based on such results, the protocol for preventive treatment against infestation caused by the sea lice would be established.

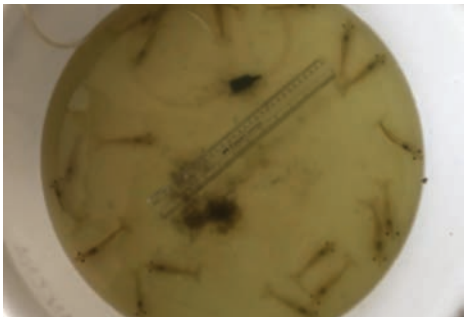


Caligus *sp.*

Whiteleg shrimp. On the production of *Penaeus vannamei* or whiteleg shrimp using biofloc system, a sludge removal facility was tested to demonstrate the productivity of old earthen ponds during the wet season. *P. vannamei* were cultured in two ponds, fed commercial pellets and given commercial probiotics during water culture and during actual culture. At 81 days of culture, the average body weight was 12.18 g and survival rate was 91.15%. After the live shrimp samples were submitted for screening of bacteria, AHPND and WSSV, the stocks were found to be disease-free.



Shrimps before treatments (feeding of commercial pellets and given commercial probiotics)



Shrimps after treatments (feeding of commercial pellets and given commercial probiotics)

Seaweeds. In safeguarding the seaweeds from pests and diseases, initial molecular identification of epiphytes was conducted to develop detection protocols and diagnostic tools for controlling seaweed diseases and pests. While the protocol needs further optimization, sampling was conducted in the Provinces of Palawan and Zamboanga in the Philippines. In the selected sites (Palawan: Honda Bay in Puerto Princesa City and municipalities of Balabac, Quezon, and Taytay (Pamantalon and Pularaquen); Zamboanga: Layag-layag, Tigtabon, and Arena Blanco), the occurrence of *ice-ice* and endophytes were assessed on-site. The results indicated the presence of ice-ice and epiphytic filamentous algae (EFA) ranging from 0.2-10.2% and 0-11.2%, respectively, for the eight farms visited. Interestingly, *Sargassum* sp., was observed at higher degree of occurrences with 33.0% and 41.3% in Pamantolon and Pularaquen, respectively.

Upon the observation of other macro-epiphytes including *Ulva* in five farms, and in *Gracilaria* farms in Tigtabon (Zamboanga), the results suggest that there is widespread occurrence of *ice-ice* and epiphytic pests in these farming regions, albeit in varying degree of infection and/or infestation rates, reflecting the current declining production of the seaweeds in the country. The collected seaweed samples with epiphytes will be analyzed through histology, electron microscopy and molecular processes for proper identification of the epiphytes. Farming of *Kappaphycus striatus* (sacol) was conducted in an identified sentinel farm in San Dionisio, Iloilo, Philippines, where the farm's environmental parameters and results of monthly seaweed biomass sampling are being monitored and recorded.

Nutrition and Feed Projects

Pompano. On the requirements of pompano for leucine, isoleucine, and histidine, its requirements for the essential amino acid (EAA) had been determined to develop a cost-effective feed for this species. Test diets have been formulated to contain different levels of the specific amino acid, and tried for 70 days in pompano to determine its histidine requirement. The results showed that the dietary requirement of pompano for histidine is 1.61%. The first run for the leucine and isoleucine requirements were also undertaken using test levels of amino acid, *i.e.* 2.1-3.8 and 1.1-2.8 g/100 g, respectively. The results showed that the amino acid requirements were around 2.8 g leucine and 1.4 g isoleucine per 100 g diet. However, most of the deficiency signs such as open gill operculum, cataract, and eroded fin were observed at these values. Second run for the requirements for the said EAA would be carried out to verify the results obtained.

In testing whether spray-dried hemoglobin powder meal could be a good source of protein for growth of marine fishes, spray-dried hemoglobin meal was given to pompano maintained in net cages at AQD Igang Marine Station. The hemoglobin powder meal, which was sourced from porcine and processed using a spray drying technique, contains 92% crude protein and has a 99% protein digestibility. The results indicated that the dietary levels of dried hemoglobin meal ranged from 3% to 27%. While the experiment is ongoing, the RNA expression of the liver and intestine will be analyzed as an effect of the different levels of hemoglobin meal in the treatment diet.

Pompano harvested in AQD given the spray-dried hemoglobin powder meal (above)

Tiger shrimp. The utilization of unfermented, fermented, and live green microalgae *Chaetomorpha linum* as food source for the tiger shrimp (*Penaeus monodon*) was evaluated. *Chaetomorpha* seaweed with known potential benefit in cultured shrimps and other farmed aquatic species, was used as food source and given either through its inclusion in formulated feeds or by direct feeding through a co-culture system. Since the algae with about 15% crude protein could be used as feed ingredient after fermentation to enhance the levels of nutrients, the fermentation protocol has been optimized. The partial counts indicated that although the highest total number of particles (TNP) at 1.83 x 10^8 particles/ml was produced using an enzyme concentration of 750 µL per 100 ml base material and incubation period of 60 minutes, lower concentrations showed to be effective as well. Results of the experiments on survival and growth of tiger shrimp given feed containing unfermented *Chaetomorpha* meal indicated that growth in terms of percent weight gain and growth rate of shrimps fed 0 to 10% inclusion remained comparable up to 120 days of culture, suggesting that the inclusion of unfermented *Chaetomorpha* meal of up to 10% does not adversely affect shrimp growth. While the apparent nutrient digestibility experiment of the algae in shrimp is currently on-going, the results will be compared to control diet and two other reference diets. From the results, the efficacy of unfermented *Chaetomorpha* meal for other species (*e.g.* tilapia juvenile and milkfish) would also be evaluated after its incorporation in the fish diets.

Indian white shrimp. On the production of the Indian white shrimp (*Penaeus indicus*), its growth was monitored when given the *P. indicus* feeds (34-40%) and low-cost tilapia feeds (28-35%) to compare and demonstrate the profitability of semi-intensive pond culture of P. indicus. Stocking of PL20 was done in four ponds with biosecurity measures, and harvested after 90-day culture period. Results showed that the percent survival of shrimps fed the tilapia diet was 69.9% and 70.0%, while shrimp fed shrimp formulated diet was 75.1% and 81.8%. The growth rates of shrimps given the two feeds were comparable however, the cost of tilapia feeds is cheaper than that of the *P. indicus* feeds, making the former a more cost-effective option.

Harvested P. indicus *from AQD's*

Dumangas Brackishwater Station ponds

Achievements: Low-cost feeds developed for more affordable fish

The AMSs had already learned from the experience of AQD on the development of low-cost feeds for milkfish and tilapia which had been successfully verified through field-testing for cages and ponds in different locations. The new formulation hopes to lower the cost of fish farming, make fish more affordable for the people, and reduce aquaculture's reliance on fish-based ingredients. Using this new formulation, AQD had in fact, successfully reduced the cost of feeds by 30 percent compared to commercial feeds available in the market. By making use of cheaper alternative ingredients, the low-cost feeds being promoted by AQD also showed higher growth and weight performance compared to commercial feeds.

The other AMSs could also learn from the results of the field testing for milkfish in sea cages that AQD carried out at its Igang Marine Station in Guimaras. Supported by the Philippine National Fisheries Research and Development Institute (NFRDI) and the Bureau of Fisheries and Aquatic Resources (BFAR), this activity had shown that the feed cost can still go down if the feed is produced in a bigger scale. As requested by the Philippine Government, AQD has moved forward with the mass production of the formulation while BFAR is looking for demo-farms to test the feeds. Once the trials prove successful, AQD will provide the formulation to private feed manufacturers for adoption, not only in the Philippines but also to the other AMSs.

2.5 Development of responsible and sustainable aquaculture technologies

Maintaining Environmental Integrity through Responsible Aquaculture

Integrating environmental factors in the development of sustainable culture technologies has been one of the pillars that AQD upholds. The Program "*Maintaining Environmental Integrity through Responsible Aquaculture*" is therefore being implemented to conduct scientific assessments of the adverse effects of aquaculture on the natural environment and to establish procedures on how these negative impacts could be mitigated in order to sustain healthy ecosystems in aquaculture areas. Development of aquaculture techniques and technologies by AQD, for various species of finfish, crustaceans, mollusks, and new emerging aquaculture species, is meant not only to enhance sustainable seafood production in the Philippines and other countries in the Southeast Asian region but also to safeguard the integrity of the coastal and aquatic environments.

Milkfish. In the development of an efficient feeding technique for milkfish in marine cage grow-out culture, physiological studies were undertaken to understand the compensatory growth response of milkfish. Starvation trials in milkfish fingerlings (~20 g) and juveniles (~100 g) have shown that compensatory growth response is primed after two to four days of starvation wherein liver energy reserve (*i.e.* hepatosomatic index) has reduced to minimum level associated with increased circulating levels of cortisol. Subsequent studies will look into the recovery of normal physiology and lost growth during period of refeeding in fingerlings and juveniles. Phenotypic observations will be verified through genetic analyses utilizing the milkfish reference transcriptom (brain, pituitary gland, gut and liver) that had been already established. A feeding schedule consisting of cycles of starvation and refeeding will then be established and tested for milkfish grow-out culture in marine cages.

Oyster. Aquaculture expansion in the 1980s led to the immediate boom in shrimp production especially in the Philippines and Southeast Asia as a whole. However, the advent of diseases starting from the late 1990s has left many of these brackishwater ponds to be unproductive until today. To make use of these abandoned ponds, field tests and studies are being conducted to explore the potential of diversifying the commodities that could be cultured in these ponds. A potential commodity with high demand and economic value would be oysters. Traditionally, in the Philippines, oysters had been cultured in brackish rivers and estuaries. A current study at AQD, which aims to assess the growth and survival of oyster *Crassostrea iredalei* cultured in brackishwater pond by comparing production with those cultured in a nearby river, is a follow-up to the recently concluded study funded by the Department of Science and Technology-Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development (DOST-PCAARRD) which identified the 'pouch method' as the best strategy in producing single oysters with fast growth and homogenous sizes. The experiment using rafts and pouches commenced using a total of 3,000 oyster spats. After three months, higher survival was observed in the river set-up (86%) compared with those inside the ponds (32%) which might have been caused by mortality inside the ponds due to predation of crabs. Growth was also higher for oysters from the river (8 cm) than from the pond (7 cm) after 5 months which could be associated with water conditions since higher temperature, salinity, sulfide and nitrite where recorded in the ponds than in the river, although the river also registered higher nitrate, phosphate and ammonia.

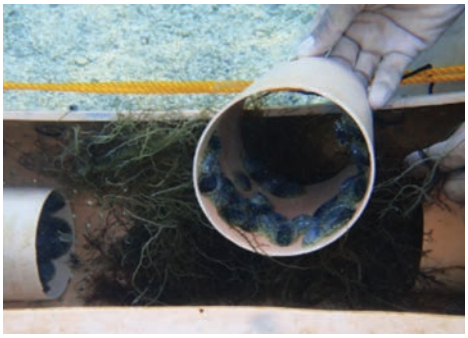
Pouch method for oyster culture

Oyster Crassostrea iredalei *harvested from the experimental sites*

Rafts set-up in brackishwater pond in Brgy. Pawa, Panay, Capiz

Rafts set-up in Arellano River

Abalone. While refining its aquaculture technology and making it more environment-friendly, AQD is developing an alternative culture method using PVC pipes as culture container and natural food (seaweeds (*Gracilariopsis heteroclada*)) as feeds for abalone culture. A collaborative effort with Ayala Corporation, as part of the industry collaboration initiative which targets local island-based communities as beneficiaries, the alternative culture system makes use of perforated PVC pipes which has previously shown to promote good growth and survival in abalone culture, while being practical and easy to deploy. In AQD's earlier culture trials, stocking of about 6,000 abalone juveniles at Sicogon Island in northern Iloilo, Philippines led to successful harvests of abalone after 3 months of culture. By October 2019, a total partial harvest of about 1,500 was recorded. This project would be turned over to the private partner and local communities as part of AQD's commitment in disseminating its developed aquaculture technologies.



Abalone in PVC pipes stocked in Sicogon Island, Philippines

Abalone harvested in Sicogon Island, Philippines

Sea cucumber. AQD has been in the forefront of developing technologies in the culture of emerging species, particularly of the tropical sea cucumber *Holothuria scabra* or sandfish. The culture of this tropical species is gaining more popularity in the recent years, and is mainly aimed to augment the drastic decline of sea cucumber populations in the wild caused by overfishing. Starting with streamlining the sea cucumbers production methods by optimizing culture technologies from hatchery, nursery and grow-out in sea ranch sites, this project was carried out in collaboration with the Australian Centre for International Agricultural Research (ACIAR) and various universities in the Philippines. Also conducted in Viet Nam, the project is intended for five years, where the first year is focused on optimizing hatchery production by utilizing micro-algal concentrates in order to minimize dependence on live feed, which is often the bottleneck in small-scale hatcheries. Initial trials showed

promising results using ISO1800 and Shellfish1800 (commercial Instant Algae® products from Reed Mariculture Inc., USA), although further assessments would be conducted. Nursery rearing trials focuses on sea-based floating nets because this is one of the most practical method based on results of previous studies. Secondary nursery in pens at AQD's Igang Marine Station (IMS) are also being assessed, although initial challenges revealed that predation is a major risk in the culture of sandfish in the field. Further studies on predation mitigation measures would also be explored.

Floating primary nursery cage for sandfish at AQD's Igang Station in Guimaras, Philippines

Fast-growing sandfish at AQD's Igang Station nursery pens

Polychaete. Marine worms or polychaetes, which are used as an additive in maturation feeds to enhance the reproductive performance of crustacean and fish broodstock, are also known to be good potential bioremediators of muddy sediments. Thus, enhancement of the culture methods for polychaetes is being explored considering its potential as feed ingredient. Since polychaete needs to be disease-free, this requires that it should be produced in controlled environments like in land-based raceways using hapa nets. Results of a stocking density experiment showed that as high as 2,000 polychaetes could be stocked per one square meter. In a culture duration of only four months, the yield could give a biomass of >100 g/m^2, while the soil organic matter content could be reduced from >5% to 3.8% after four months, confirming the bioremediation potential of this species.

Raceway culture experiment system for polychaetes using hapa nets

Achievements: Off-season spawning of milkfish breeders achieved
The Philippines could now avail of the technology being promoted by AQD related to the environmental manipulation on milkfish breeders that successfully facilitated two spawning events even during the cold season that began December 2019. December until February is commonly known as off-season for milkfish spawning because of low temperatures. With environmental manipulation, AQD was able to achieve year-round spawning to boost the production of milkfish fry which are in short supply in the Philippines.

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

Adapting to Climate Change

Climate change is already happening, and there is little doubt that global warming is occurring and at a greater rate than previously predicted. The recent extreme weather disturbances like more frequent and stronger typhoons, long dry spells resulting to droughts, frequent heavy rains resulting to severe flooding are some of the phenomena that are linked to climate change. These changes are projected to impact broadly across ecosystems and economies, increasing pressures on all livelihoods and food supply chains, including those in the fisheries and aquaculture sector. The future food supply will be a central issue as food resources come under greater pressure, and the availability and access to fish supplies will become an increasingly critical development issue.

Climate change is a compounding threat to the sustainability of aquaculture development. Impacts occur as a result of gradual warming, the increasingly acidity of the oceans and associated physical and chemical changes as well as from frequency, intensity and location of extreme climatic events. How these changes affect the aquaculture organisms in general, the different aquaculture systems and structures, the various support systems to aquaculture operations, and to the fish farmers in the region who are highly vulnerable since they are dependent on their aquaculture operations for food and income, need to be assessed. Urgent adaptation measures are also required to respond to the threats to food and livelihood provision due to climatic variations. Although there is no activity that would

directly addressed the abovementioned issues and concerns, several activities under AQD's Departmental Programs also address the need to mitigate the impacts of climate change. Moreover, information on the impacts of climate change on aquaculture and the mitigating measures are incorporated in the training courses offered by AQD.

Furthermore, the efforts of AQD to determine the effects of temperature and salinity on the reproduction of copepods that are potential food during fish and crustacean seed production, effects of salinity and pH on growth of seaweeds and growth of green algae used in rotifer culture, comparing the effects of water temperature on the mating performance of captive and wild shrimp broodstock, and the effect of abrupt salinity fluctuations on the early recruitment of sandfish, also address climate change issues. The past and current activities on the evaluation of potential feed ingredients from various sources (*e.g.* industrial, agricultural and fish processing by-products) as replacement for fish meal and fish oil help address constraints of diminishing supplies of fish meal and fish oil in light of the expected impacts of climate change on global fishery resources. For example, based on previous work on alternative ingredients, a low-fish meal feed (1-2% fish meal) for tilapia and milkfish is now being field tested, and the information on nutrient profiles of these ingredients could be added into the Regional Feed Ingredients Database. These initiatives contribute to the overall resilience of the aquaculture sector in the region to the impacts of climate change.

The ongoing studies on persistent and emerging diseases (white spot syndrome, acute hepatopancreatic necrosis diseases, enterocytozoon hepatopenaei, nervous necrosis virus, tilapia lake virus, as well as other viral, bacterial, and parasitic diseases), as well as the development of measures to prevent and control disease outbreaks (*e.g.* vaccination, immunostimulation, greenwater culture) likewise address climate change issues. Formulation of policy recommendations as well as development of guidelines for the establishment of an early warning and response system for disease outbreaks based on the outcomes of Regional Technical Consultation on this issue help improve capacity in dealing with disease outbreaks in the region. This system could be linked to other initiatives like the warning system for harmful algal blooms or fish kills, and contribute further to building resilience to the impacts of climate change. The current initiatives in promoting community-based resource enhancement and aquaculture-based community livelihood programs also improve the resilience of coastal communities, one off the most affected sector of society, to the impacts of climate change.

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

Meeting Social and Economic Challenges in Aquaculture

The development and implementation of social and economic strategies in aquaculture and resource management are meant to secure food and income through stakeholders collaboration. This is in response to the specific recommendation for meeting the social and economic challenges in aquaculture which were identified and adopted during the ASEAN-SEAFDEC Fish for the People Conference in June 2011. So far, the outcomes that emanate from studies on various aquaculture commodities (*e.g.* mangrove crab, milkfish, sandfish, seaweeds) include enhanced understanding of aquaculture's role in poverty alleviation, issues on climate change and aquaculture trade addressed with emphasis on those affecting small-scale fish farmers, and multi-agency collaboration and information sharing enhanced.

Mangrove crab. Selecting the optimal stocking density of mangrove crab *Scylla serrata* in hatchery production in different seasons using a decision theory approach was initiated to establish the optimal stocking density of mangrove crab hatchery production during dry and wet seasons, taking into account water temperature uncertainty and the risk preferences of producers or farm decision-makers. Therefore, the data generated would be evaluated using the decision theory approach integrated with the bio-economic model of the mangrove crab. Preliminarily, results of the crab instar harvest provided the completed larval cycle (from early to crab instar) with stocking density of 60 zoeas per liter, with observed average ammonia level at (0.88 ppm) which is less than the normal range of ≤1 ppm, and nitrite level of 0.29 ppm which was higher than normal at ≤0.1ppm but the crab larvae were able to tolerate it. While temperature (29.9°C) and dissolved oxygen (4.91) were within the optimum level (27-30°C and >4ppm, respectively), the crab larvae survival was 1.00% which is reasonably satisfactory compared to the 80 zoeas per liter survival of 0.37%. Subsequently, a second batch completed the larval cycle with a survival rate of 60 zoeas per liter which is tripled (3.4%) compared to the previous run, while 80 zoeas per liter exhibited a much lower survival rate of 0.8%. These initial results indicate that mangrove larvae perhaps have high tolerance to nitrogen loading in the environment that could be associated with increasing anthropogenic activities and climate change parameters. These environmental conditions have significant implications to the multi-million mangrove crab aquaculture industry. However, bio-economic modeling and further analysis require more datasets.

Monitoring of water parameters in tanks stocked with mangrove crablets

Milkfish, sandfish, and seaweeds. The Integrated Multi-Trophic Aquaculture (IMTA), which was implemented by AQD from 2015 to 2019 in collaboration with Japan International Center for Agricultural Sciences (JIRCAS), was aimed at developing technologies for sustainable aquatic production in harmony with tropical system. The role of aquaculture in addressing poverty in the fisheries sector has been elucidated given the economic and social challenges experienced in the implementation of IMTA of milkfish (*Chanos chanos*, Forsskal), sandfish (*Holothuria scabra*), and seaweeds (*Kappaphycus* sp). The seven IMTA production runs had been co-managed by local fisherfolks, women, and local government in Barangay Pandaraonan in the municipality of Nueva Valencia in Guimaras Province. The biophysical and socioeconomics data collected from these seven runs provided basis for evaluating the IMTA results during summer and rainy seasons. The last run of the IMTA of milkfish runs indicated that of the 5,000 milkfish juveniles stocked, 92.8% or 1.25 metric tons (mt) were harvested, 0.8% died and 6.4% were uncounted. Profitability was primarily constrained by a combination of factors that include high production cost due to total cost of feeds used that comprise 64% of the variable cost. While the cost of fingerling

accounted for 16% of the variable cost, the unrecovered proportion of stocks due to probable poaching, escapees and unrecorded mortalities also dented the profitability. Re-investments in terms of replacement of depreciated bamboo poles in the pen likewise increased the fixed cost. The harvest of co-cultured sandfish and seaweeds also needs enormous improvement because the high-value co-culture species are supposed to overcome the impact of increasing production cost, aside from mitigating the impact of organic matter. Nonetheless, monitoring of environmental parameters such as organic matter and other pollutants did not indicate significant deterioration in open culture system. Community-based strategies to overcome economic losses need further study in order that the application of IMTA would benefit the potential adopters of this technology.

In view of these social challenges in community-based implementation of IMTA in milkfish culture, characterization and levels of improvement of sustainable livelihood assets were determined for this community-based project. Fifty-two stakeholders were interviewed in 2019 for an inter-temporal analysis of sustainable livelihood assets (SLA) relevant to the implementation of community-managed IMTA in rural coastal communities. Using inter-temporal Likert-scale rating, the analysis showed improvement of four out of five categories of livelihood assets such as human, environmental, financial, and social assets associated with this IMTA project. In contrast, physical livelihood assets (such as pens, cages, fish value-adding equipment) did not significantly improve as perceived by the fisherfolk stakeholders, which could be due to limited mariculture pens used that could only accommodate a few of the many fisherfolk stakeholders. The utilization of the physical livelihood assets was dissipated and thus limited for the many expectant project beneficiaries. Therefore, there is the need to organize more and bigger collaborative projects with emphasis on sustainable livelihood asset development that would create significant impacts to the poor fishing households in coastal communities.

Milkfish produced from the seventh run of the community-based IMTA setup in Barangay Pandaraonan in Guimaras, Philippines

Achievements: Environment-friendly tiger shrimp farming demonstrated
The AMSs could now avail of the technology developed by AQD that makes use of the environment-friendly green water technology. Using such technology, AQD harvested a total of 7.2 tons of tiger shrimp from two harvests on 28 October and 13 November 2019 from its Dumangas Brackishwater Station, and gained commendations from the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) and other stakeholders. The AMSs could take heed of the successful harvests of AQD that tiger shrimp farming, if implemented correctly, is still a profitable venture. Tiger shrimp, *Penaeus monodon* was widely cultured in the region in the nineties until the emergence of shrimp diseases caused steep declines in production. AQD's program, "Oplan Balik Sugpo," aims to revive the industry. The harvest in November of 4.4 tons attained a survival rate of 89.7 percent after 120 days of intensive culture in an 8,000 square meter experimental pond. In October, 2.8 tons was harvested with a survival rate of 93 percent after 113 days of semi-intensive culture in a 5,000 square meter pond. The high health shrimp fry stocked in the ponds were produced in AQD's newly developed biosecure hatchery in Tigbauan, Iloilo. The AQD culture method uses green water technology that stabilizes water quality and naturally suppresses the harmful luminous and other *Vibrio* bacteria that cause massive mortality in shrimp. This is done by stocking tilapia and milkfish in the pond which was also fitted with sludge collectors and surrounded by crab fences. Proper pond preparation, management, strict biosecurity practices, and regular monitoring of water and shrimp samples are equally necessary to ensure the success of tiger shrimp farming. The successful harvests and the details of the hatchery and grow-out technology were disseminated to the shrimp industry during the 12th Philippine Shrimp Congress in November 2019 in Bacolod City, and the information could also be shared with the other AMSs.

2.8 Collaborative Projects with the Philippine Government

Over the years, the AQD has developed technologies in broodstock development, seed production, and grow-out as well as feeds and nutrition of economically-important finfishes, crustaceans, mollusks, and seaweeds in various stages of development. Several of these technologies have already been successfully field-tested in ponds, pens, and cages in fresh, brackish, and marine waters in collaboration with fish pond operators, local government units, non-government organizations, and other international organizations. In an effort to also support the thrusts of its host government, AQD has pursued two aquaculture projects with the collaboration and support of the Philippine Government.

Joint Mission for Accelerated Nationwide Technology Transfer Program (JMANTTP II)

To accelerate fish production and export revenues from the aquaculture sector, AQD is committed to intensifying techno-transfer of matured aquaculture technologies to stakeholders which will provide additional and alternative livelihood to fisherfolks through sustainable aquaculture technologies that are economically viable, environment-friendly and socially equitable. This project is being implemented in collaboration with the Philippine Bureau of Fisheries and Aquatic Resources (BFAR).

Operation Black Tiger Shrimp Revival. Locally called as *Oplan Balik Sugpo*, this is aimed at reviving the shrimp production as well as providing farmers with good quality shrimps for grow-out culture in the Philippines after the drastic decline of this commodity since the late 1990s. The technology demonstration projects are divided into two phases, the first phase of which had been started at AQD's Dumangas Brackishwater Station (DBS) with technology demonstration runs on low or partial discharge and closed-recirculating system of shrimp farming using environment-friendly schemes at the intensive, semi-intensive, and modified extensive levels of production. Successful technology demonstration runs will then be followed by the implementation of Phase 2, wherein demonstration projects will be conducted in private commercial shrimp farms whose owners have requested technical assistance from AQD on shrimp farming. In support of this concern, the shrimp hatchery complex of AQD had been equipped with its own spawner or broodstock facility for pathogen detection of newly-arrived spawners. The shrimp hatchery utilized spawners from the wild which could be processed and analyzed before and after spawning to determine the presence of pathogens. After spawning and if tests resulted positive, nauplii are chlorinated and discarded. Nauplii that were tested positive of diseases are stocked on modules containing tanks for larval rearing until they reached the postlarvae stage and were harvested. The hatchery is equipped with several larval rearing tanks divided into two modules which allows resting of the other module after stocking, and with several filtration systems to ensure good water quality for the stocks. Seawater from the source will first pass through the sand filter before it reaches the reservoir. From the reservoir, it will pass through the rapid sand filter, then through the UV sterilizer before reaching the larval rearing tank equipped with filter bag. Fry are harvested upon reaching the PL20 stage. Thus, disease-free fry had been stocked at Dumangas Brackishwater Station ponds for the experimental grow-out run.

By practicing this environment-friendly scheme, over 2.80 mt of tiger shrimp had been harvested from a 0.5-hectare pond after 113 days of culture, where 93.3% of the 100,000 postlarvae stocked survived and attained an average body weight of 30 grams.

Shrimps harvested from AQD's Dumangas Btrackishwater Station ponds

Shrimp harvested from the Oplan Balik Sugpo scheme in October 2019

Thereafter, another 4.40 tons of tiger shrimp with average body weight of 30 g, were harvested from a 0.8-hectare pond after 120 days of culture yielding a survival rate of 89.7%. More runs will be conducted to verify the culture system and once verified and proven effective, the technology will be adapted by BFAR Region 6 to be demonstrated in their technology outreach stations in Negros and Aklan, and subsequently introduced to fish farmers in these areas.

In situ Training Courses. As part of introducing sustainable aquaculture technologies that are economically viable, environment-friendly, and socially equitable that were developed by AQD, nationwide techno-caravan, field demonstrations, and hands-on training are being organized with support from BFAR. Firstly, AQD and BFAR need to conduct field evaluations of BFAR's national aquaculture centers and regional stations, and identify the appropriate technologies that would be demonstrated thereat. This technology transfer would allow fish farmers, entrepreneurs, and other end-users to acquire additional and alternative livelihoods. Several training courses have already been conducted in different regions to promote sustainable aquaculture technologies, with fish farmers, fishpond owners, and operators as the recipients of these on-site training courses, which include the following:

a) *Freshwater aquaculture training course at the University of Southern Mindanao in Kabacan, Cotabato, Philippines*. Sixty-eight (68) fishpond owners, farmers, and operators from Region 12 participated in the training course conducted through the collaborative effort of AQD and BFAR-12. The four-day training course on 25-26 February 2019, focused mostly on freshwater commodities like tilapia, milkfish, giant freshwater prawn, and catfish. As planned, the training comprised lecture series on the first three days and practical sessions on the fourth day that included packing and transport of tilapia fry, proper acclimation and stocking of fry in ponds, water quality parameters monitoring, and feed preparation for sex reversal of tilapia. The participants were also provided with free manuals and brochures that they can use for their aquaculture operations.

AQD Scientist Dr. Frolan Aya *demonstrates induced spawning of catfish in Cotabato, Philippines*

b) *Marine aquaculture of high-value species training course in Tacloban City, Leyte, Philippines*. Conducted on 20-22 May 2019, the training focused on marine aquaculture of high-valued aquaculture species like groupers, seabass, and pompano among others. Sixty-four participants, who are training officers and fish growers from Region 8, availed of the training which was organized free of charge.

c) *Milkfish training course in National Mariculture Center, Panabo City, Davao del Norte, Philippines*. Organized on 15-18 October 2019, this training course focused on milkfish culture with topics on the biology of milkfish, broodstock management and seed production, pond preparation, and nursery and grow-out culture in ponds and cages. Other related topics were discussed including biosecurity measures/protocols and fish health management. Practical sessions, such as harvesting and transporting of fry as well as monitoring of the water quality parameters, were also made part of the training.

AQD scientist Dr. Roger Edward Mamauag *lectures about the status of the milkfish industry during the training in Panabo City, Philippines*

Manpower Development. AQD has been developing the human resources for aquaculture development in the Philippines. With the objective of increasing the number of fish farmers in the country, AQD recently trained a batch of fisheries graduates in hatchery seed production as well as pond culture using different culture systems. Successful graduates of this rigorous and in-depth training would be deployed to the various AQD projects or be recommended to various related government offices, non-government, or private business sector. After finishing the course, the trainees would have already gained knowledge of shrimp, marine fish, and tilapia aquaculture technologies. In 2018, sixteen (16) graduates from different fisheries schools in Western Visayas graduated with enhanced capabilities and broadened perspectives and experiences in shrimp and multi-species marine fish hatchery operations, including cage and brackishwater pond culture operations. After three months of intensive training, the graduates had already been assigned to different areas and hatcheries of AQD. Few of the graduates upstarted the operation of BFAR-5 multi-species hatchery in Sagnay, Camarines Sur in the Philippines. The hatchery produced a total of 467,000 fry all of which were sold. Another similar training course is planned for 2020 to produce another batch of capacitated trainees. This time, fisheries graduates from different fisheries schools mostly from Mindanao, Quezon, and Bicol areas are the target individuals for training and deployment in constructed legislated hatcheries.

Manpower development graduate now going into actual fish hatchery operation in Sagnay, Camarines Sur

Profiling of Hatcheries in Iloilo, Philippines. To increase fry production of various aquaculture commodities in the Province of Iloilo, AQD has provided technical assistance to BFAR 6 on the rehabilitation of non-operational, abandoned, or damaged hatcheries. In profiling the hatchery structures in the first district of Iloilo, AQD recorded nine hatcheries that are operating and culturing tilapia, shrimps (*Litopenaeus vannamei* and *P. monodon*), milkfish and seabass. On the other hand, twelve hatcheries were listed as abandoned or non-operating due to sickness or death of owners, bankruptcy, or lack of finances to continue operations. It was also noted that most abandoned hatcheries used to culture *P. monodon*. This activity was carried out in order to collect baseline information for the possible rehabilitation of non-operational hatcheries in the area for maximized production of milkfish fry. AQD is now coming up with the recommendations, cost estimates, and other technical plans for the rehabilitation of the identified hatcheries, for consideration and approval of BFAR.

Abandoned hatcheries located in San Joaquin and Guimbal in Iloilo, Philippines

Feasibility Study of Legislated Multi-Species Hatchery. In accordance with the Memorandum of Agreement (MOA) between BFAR and AQD, the areas of selected legislated multi-species hatcheries were evaluated during the 16th and 17th Congress Sessions. This feasibility study is in line with the "Bangus (milkfish) Fry Sufficiency" program of BFAR which aims to give emphasis on the current and future milkfish fry requirements of the Philippine aquaculture industry. Once constructed, the legislated multi-species hatcheries would serve as one of the central milkfish hatcheries providing the seed requirements of grow-out facilities, like ponds, pens, and cages within the various regions of the country. So designed, each marine hatchery is capable of producing 25 million milkfish fry annually, although the facility is designed for milkfish, it is still capable of accommodating other marine species (*e.g.* shrimp, pompano, mangrove crab). Aside from fry production, the hatchery facilities would also serve as a training venue for interested private groups planning to put up hatcheries. In the future, the facilities would also serve as venues for on-the-job training and/internship of fisheries students, as hands-on training on the various aspects of the hatchery operations could be organized through the respective resident technicians. Moreover, the facilities could can also serve as demonstration facilities to show timely innovations that might be developed through years of operation. In 2019, AQD evaluated the new sites in Hinatuan and Surigao City in the CARAGA region (Mindanao) as well as another site in Quezon Province (Luzon). Three sets of engineering layouts and detailed feasibility studies of the aforementioned sites were successfully turned over to BFAR Central Office, respective BFAR Regional Offices, and local government units. Meanwhile, detailed feasibility study reports

for the following sites have been prepared and submitted to BFAR: Perez, Quezon (RA 10945); Sultan Naga Dimaporo, Lanao del Norte (RA 10860); and Jose Dalman, Zamboanga del Norte (RA 10859). This means that six (6) out of the 15 legislated areas listed in the MOA have already received the engineering plans and feasibility studies reports. In fact, one of the sites, *i.e.* in Lingig, Surigao del Sur under RA 10787, had already started the construction of the multi-species marine hatchery which is expected to finish around the second quarter of 2020. Meanwhile, construction of the hatchery in Del Carmen, Surigao del Norte under RA 10825, had started during the last quarter of 2019. Construction of the only freshwater multi-species hatchery in Jabonga, Agusan del Sur under RA 10813 would start upon completion of the bidding processes.

On-going construction of the hatchery in Lingig, Surigao del Sur

Development of Cost-Efficient Feeds

Traditionally, fish meal provides a major part of the protein sources in formulated feeds because of its suitable protein quality. However, the recent scarcity and uncertain consistency of supply encouraged the stakeholders to opt for its replacement by alternative protein sources that are of high quality, but less expensive. Limitations of the world's food supply also provide the additional motivation and options that have been investigated in many fish species. Numerous studies have therefore been undertaken to examine the effects of replacing fish meal by another sources of protein in diets, such as animal by-products or plant-based protein. With this, AQD and the Philippine National Fisheries Research and Development Institute (NFRDI) of BFAR have developed the plans to identify and utilize cost-effective feed ingredients that could be used as alternatives to fish meal. Considering that the average cost of a commercial feed is between PhP 34.00 to 36.00 per kg (USD 0.65 to 0.71) which is quite high, this cost could be compared with the AQD formulated diet which costs only about PhP 19.00 to 22.00 per kg (USD 0.37 to 0.43).

Milkfish in floating net cages. For the culture trials for milkfish in floating net cages at AQD's Igang Marine Station (IMS), milkfish juveniles with average body weight of 33 g were stocked in six (6) 5 x 5 x 3 m floating net cages at a stocking density of 33.4 fish per m^3 (2,500 fish per cage) in June 2019. Two dietary treatments (AQD formulation and commercial grower feeds) were used with each treatment having three replicates. Sampling of stocks was conducted every 30 days, and after 120 days of culture, milkfish fed the AQD diet attained a total of 2,795.30 kg upon harvest, which was higher compared with the milkfish fed the commercial feed at 2,234.92 kg upon harvest. In terms of average

body weight, milkfish fed the AQD diet gained 393.45±66.57 g while the commercial diet-fed milkfish gained up to 325.35±65.20 g. As for the feeding performance of milkfish fed the AQD and commercial diets, a total of 5,870.36 kg and 5,419.70 kg was consumed, with feed conversion ratio of 2.1 and 2.43, respectively.

Tilapia in ponds. Feeding experiment for tilapia, carried out in partnership with NFRDI Muñoz, Nueva Ecija, was initiated last 27 June 2019. Tilapia fingerlings with average body weight of 21 g were stocked in 6,300 m^2 ponds at a stocking density of 5 fish per m^2 (1,500 fish per pond). Two dietary treatments (AQD formulated and commercial grower feeds) were used with each treatment having three replicates. The experiment was terminated when the fish reached marketable body weight of 300-350 g. Sampling of stocks was being conducted every 30 days. The second feeding experiment for tilapia was conducted at Lala, Lanao del Norte starting 17 September 2019. Tilapia fingerlings with average body weight of 11 g were stocked in 6,200 m^2 ponds at a stocking density of 5 fish per m^2 (1,000 fish per pond). Two dietary treatments (AQD formulated and commercial grower feeds) were used with each treatment having three replicates. The experiment was terminated when the fish reached marketable body weight of 300-350 g. Sampling of stocks was being conducted every 30 days.

After 120 days of culture, the experiments harvested a total of 1,097.93 kg for tilapia fed the AQD diet and 1,023.50 kg for tilapia fed the commercial diet with average body weight of 338.45±55.88 and 308.28±63.27, respectively. Results also showed that tilapia fed the AQD diet consumed more feed (1,633.41 kg) compared with those fed the commercial feeds (1,557.85). As for feed conversion ratio, results gave 1.35 for AQD diet and 1.52 for the commercial feeds.

The collaborative projects with Philippine Government agencies aim to accelerate technology transfer through new thrusts. In 2020, AQD will continue to harmonize relevant research and development studies prioritized by the Philippine Government as host of AQD. Through these collaborations, DA-BFAR, NFRDI, and other government agencies could assist AQD in transferring adaptable and sustainable technologies to the industry and stakeholders. Fish farmers would benefit from the projects as they will immediately reap the gains from the research done by AQD.

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, the 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 (its name changed to Singapore Food Agency in April 2019), 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 the Diarrhoetic Shellfish Poisoning (DSP) toxins, lipophilic toxins, Paralytic Shellfish Poisoning (PSP) toxins, and Tetradotoxin (TTX), as well as 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 on biotoxins analysis and monitoring, and continued with the capability building 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 along with DSP and PSP. From 2018 to 2019, 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. As a result, the capacity of the AMSs has been enhanced through the series of training courses on a range of subjects related to marine biotoxins. Results of the two-year biotoxins monitoring survey from 2015 to 2016, with extension to 2017, by Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam, had been collated into a draft "Technical Compilation," covering the respective countries' survey methodologies and recommendations as well as the problems and challenges encountered during the survey, which provided a valuable learning tool for all the AMSs. During the "End-of-Project (EOP) Meeting for Chemicals and Drug Residues in Fish and Fish Products in Southeast Asia – Biotoxins (ASP, AZA, and BTX) and Harmful Algal Blooms (HABs) in the ASEAN Region" held on 14-15 August 2019 in Singapore, the draft Technical Compilation was finalized for publication. The printed publication will be disseminated to all AMSs and will also be made available online.

Achievements: Monitoring of Biotoxins and Harmful Algal Blooms
• The AMSs had learned lessons during the implementation of the Project "**Chemical and Drug Residues in Fish and Fish Products in Southeast Asia – Biotoxins Monitoring and Harmful Algal Blooms in the ASEAN Region,**" and as a result, the regional laboratory capabilities and credibility in ASP, AZA and BTX biotoxins testing as well as the identification of toxic HAB species had been upgraded and/or enhanced • The AMSs had deepened their knowledge and understanding on the occurrences and incidences of biotoxins in fish and shellfish, and HAB species in the Southeast Asian region through the report of the monitoring surveys conducted in the ASEAN under the Project

- The AMSs could enhance their capabilities through the Technical Compilation, which is being prepared for publication, as it would serve as a useful tool in the facilitation of exchanging information among the AMSs

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

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 in the supply chain are not derived from IUU fishing, and facilitate the tracking of the flow of products through the production processes or the supply chain. 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, came up with 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 supported the promotion and implementation of the "ASEAN Catch Documentation Scheme" in pilot countries of the Southeast Asian region. Starting in 2018, follow-up activities with AMSs were carried out on their respective actions to implement the said ***ASEAN Guidelines***. In 2019, MFRDMD organized the "Terminal Regional Technical Consultation (RTC) for Combating IUU Fishing in the Southeast Asian Region through Application of Catch Certification for International Trade in Fish and Fishery Products" during 3-5 September 2019 in Kuala Lumpur, Malaysia. Attended by representatives from the ten AMSs, the RTC discussed the issues that the AMSs encountered in the implementation of the ***ASEAN Guidelines*** as well as the results of the self-evaluation on status of implementation of the ***ASEAN Guidelines*** in the respective AMSs. Results have indicated that most of the AMSs have implemented more than 80% of the articles in the ASEAN Guidelines, indicating that the AMS are committed to combat IUU fishing. The results of the self-evaluation were subsequently reported to the 42nd PCM and the 22nd FCG/ASSP Meeting in November 2019, where the AMSs were requested to continue monitoring the status of implementation of the ***ASEAN Guidelines*** in their respective countries based on the self-evaluation method prescribed by MFRDMD. The Report of the Terminal RTC and the Project Terminal Report would be published in January 2020 for dissemination to the concerned stakeholders.

Participants of the Terminal Regional Technical Consultation (RTC) for Combating IUU Fishing (3-5 September 2019, Kuala Lumpur, Malaysia)

The ***ASEAN Guidelines*** had supported the promotion and implementation of the "ASEAN Catch Documentation Scheme" in pilot countries of the Southeast Asian region. The "***ASEAN Catch Documentation Scheme (ACDS)***" is one of the regional initiatives pursued by SEAFDEC with the collaboration of the AMSs for improving the traceability of marine capture fisheries to ensure that the entry of fish and fishery products from IUU fishing activities into the supply chain is prevented. From 2014 to 2017, technical consultations and expert meetings were organized to develop the ACDS concept which was endorsed by the ASEAN during the 25th Meeting of the ASWGFi in 2017, and subsequently adopted by the SOM-AMAF Meeting, also in 2017. After the endorsement of the ACDS concept, an electronic application of ACDS or the "eACDS" was developed by TD, taking into consideration the instruction of the SEAFDEC Council of Directors that the ACDS should not create unnecessary burdens, costs or lengthy processes for the supply chain, as well as importers/exporters. Thus, the eACDS was pilot tested in Brunei Darussalam June 2017, and in the following years, in Viet Nam, Myanmar, and Malaysia.

Officials from TD, MFRDMD and Department of Fisheries Brunei Darussalam during the on-site testing of the implementation of improved eACDS in Brunei Darussalam

Brunei Darussalam

After pilot testing the eACDS in Brunei Darussalam in mid 2017, the Project Team from TD started developing the eACDS applications, and a series of consultations and on-site trainings ensued on the use of eACDS with involvement of relevant stakeholders in collaboration with the DOF of Brunei Darussalam. Subsequently, the eACDS system was applied, tested, and improved. In 2019, follow-up activities and monitoring on the use of the eACDS system were carried out from 28 to 31 January 2019, and based on the suggestions during the monitoring, the eACDS application was improved and adjusted to be more user friendly. After the improvement of the application, the TD Project Team trained the staff of the DOF Brunei Darussalam during 21-24 October 2019, on the use of the web-based and mobile applications of the improved eACDS, for offline reporting of the catch at sea.

Web-based and mobile applications (offline catch report at sea) of the eACDS introduced to the staff of DOF Brunei Darussalam during a training on 21-24 October 2019

Viet Nam

During the 40th Meeting of the SEAFDEC Program Committee in 2017, the representative from Viet Nam requested SEAFDEC to support the country in the application of eACDS for tracing its marine fishery products. In response, SEAFDEC organized a consultation with relevant stakeholders and officers of the Directorate of Fisheries (D-Fish) in Viet Nam at the end of 2017, to introduce the eACDS system, and was followed in 2018 by a discussion on the preparation of Key Data Elements (KDEs) for the eACDS database development and selection of pilot areas. In 2019, the TD Project Team continued its discussion with the Sub Directorate of Fisheries (Sub D-Fish) on 8-12 July 2019 in Binh Thuan, a selected pilot site. Subsequently, series of visits were conducted on 12-16 August 2019, 26-30 August 2019, 9-13 September 2019 and 7-11 October 2019, to verify the eACDS applications together with training on the use of the applications for officers and stakeholders, *i.e.*: 1) web-based and mobile applications of the eACDS a part of the country's Point In-Port Out system; 2) catch report at sea using offline technology and issuance of Catch Declaration (CD); 3) movement procedures for issuance of Movement Document (CD), and purchasing via mobile application; and 4) requirements for Catch Certification which had to be provided prior to the issuance of Statement of Catch (SC), and Catch Certification (CC).

Verification of Key Data Elements for development of the eACDS Database in Viet Nam

Training on the use of web-based and mobile applications of the eACDS, for officers and stakeholders in Viet Nam

Myanmar

In response to request expressed by Myanmar during the 50th Meeting of the SEAFDEC Council, for SEAFDEC to support the implementation of the eACDS in Myanmar, the TD Project Team discussed with relevant stakeholders and officers of the DOF of Myanmar in 2018 about the initial plans for the use of the eACDS in Myanmar. On 4-7 February 2019, the Project Team assisted the concerned staff of DOF Myanmar in gathering the KDEs as basis for development of the eACDS Database and its application, which was followed by the verification of the KDEs on 30 July-2 August 2019. Subsequently, the eACDS was introduced through the training of officers of the DOF Myanmar on 9-13 December 2019, and the use of the eACDS applications was made part of the country's Port In-Port Out system and issuance of Catch Declaration (CD).

Testing the application of eACDS Database by staff of the DOF of Myanmar

Malaysia

As requested by Malaysia during the 41st Meeting of the SEAFDEC Program Committee in 2018, for the country to serve as one of the project countries for the eACDS implementation with Kelantan and Kuantan selected as the project sites, the Project Team from TD introduced the eACDS system to relevant stakeholders and staff of the DOF Malaysia. Thus, initial planning and discussion on the required cooperation with the DOF Malaysia was carried out on 21-25 April 2019 at the pilot site in Kelantan, and subsequently on 17-21 June 2019, a baseline survey and analysis including collection of KDEs for eACDS

Database development was carried out in in Kuantan as the other pilot site. Based on the results of the discussions, the eACDS application as part of the country's Port In-Port Out system was developed, and on 11-14 November 2019 the application was verified with the DOF officers at its Headquarters in Putrajaya, Malaysia. In addition, a workshop for the relevant authorities of Malaysia on the cooperation and implementation of the eACDS was organized on 16-20 December 2019 in Kuala Lumpur. As of the end of 2019, TD is in the process of developing the eACDS prototype for Malaysia.

Discussion on the initial planning of the application of the eACDS in Malaysia, and seeking the cooperation with the DOF Malaysia on the eACDS

Testing of the application of the eACDS Database by staff of DOF Malaysia

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

5.1 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. As a way of addressing such concerns, the SEAFDEC Secretariat has implemented the project "**Assistance for Capacity Building in the Region to Address International Fish Trade-related Issues**" to monitor 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. The Project also provides the platform for the development of common views among the countries, and makes 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.

One of the most crucial responsibilities of the Project is to monitor the proposals for listing of commercially-exploited aquatic species (CEAS) in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and organize consultations for addressing the relevant issues that could impact on the sustainability of the region's fisheries. In so-doing, the Project facilitates the development of common/coordinated positions of the ASEAN-SEAFDEC Member Countries toward the proposals for listing of CEAS into the CITES Appendices, especially those that have been proposed for discussion at the 18th Session of the Conference of the Parties to CITES in 2019. Toward this end, the SEAFDEC Secretariat organized the "Regional Consultation for Development of the ASEAN-SEAFDEC Common Position on the Proposed Listing of Commercially-exploited Aquatic Species into the CITES Appendices" on 30-31 January 2019 in Bangkok, Thailand, where the proposals for listing of five CEAS into the CITES Appendix II were discussed. As a result, the AMSs agreed on the common position to oppose the proposal for inclusion of short-fin Mako shark, *Isurus oxyrinchus* and long-fin Mako shark *Isurus paucus* in Appendix II. SEAFDEC then shared the results of the Regional Consultation during the meeting of the "ASEAN Working Group on CITES and Wildlife Network Meeting" on 2-4 April 2019 in Sandakan, Malaysia. Subsequently, SEAFDEC supported the participation of Member Countries' representatives, *i.e.* one each from Cambodia, Malaysia, Myanmar and Viet Nam, to the 18th Session of the Conference of the Parties to CITES on 16-28 August 2019 in Geneva, Switzerland.

Participants of the Regional Consultation for Development of the ASEAN-SEAFDEC Common Position on the Proposed Listing of Commercially-exploited Aquatic Species into the CITES Appendices (30-31 January 2019 in Bangkok, Thailand)

Furthermore, SEAFDEC also participated and provided technical inputs in international events in 2019 that discussed international fisheries-related issues that could possibly have implications in the development of fisheries of the region. These include:

- Fifth Global Record Working Group Meeting (organized by FAO on 13-14 May 2019 in Seoul, Republic of Korea)
- Second Meeting of the Parties to the PSMA, and Third Meeting of the Part 6 Working Group (organized by FAO on 3-6 June, and 7 June 2019, respectively, in Santiago, Chile)
- FAO Workshop on Best Practices to Prevent and Reduce Abandoned, Lost or Otherwise Discarded Fishing Gear (organized by FAO on 8-11 July 2019 in Bali, Indonesia)
- Seventeenth Session of the FAO/COFI Sub-Committee on Fish Trade (organized by FAO on 25-29 November 2019 in Vigo, Spain)

SEAFDEC participants during the 17th Session of the FAO/COFI Sub-Committee on Fish Trade (25-29 November 2019, Vigo, Spain)

Also through this Project, SEAFDEC pursued several activities related to the directives given by the SEAFDEC Council, such as the review of the Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020 (RES&POA-2020) which was adopted by the ASEAN-SEAFDEC Member Countries in 2011. In this regard, SEAFDEC Secretariat organized the "Meeting on Way Forward of the Resolution & Plan of Action 2020" on 1-2 May 2019 in Bangkok, Thailand to review the document and identify the anticipated issues for the coming decade that should be accommodated in the document. Based on the recommendations and views shared during the first meeting, SEAFDEC subsequently developed a revised draft RES&POA Towards 2030 which was presented during the "ASEAN-SEAFDEC Regional Meeting on the Resolution and Plan of Action for ASEAN Region Towards 2030" on 10-11 September 2019 in Bangkok, Thailand. After the deliberations, the Meeting came up with the revised draft RES&POA-2030, which was submitted to the 42nd Meeting of the SEAFDEC Program Committee and the 22nd Meeting of the FCG/ASSP in November 2019, for consideration and endorsement to the SEAFDEC Council and the ASEAN in 2020.

Meeting on the Way Forward for the Resolution & Plan of Action 2020 (1-2 May 2019, Bangkok, Thailand)

ASEAN-SEAFDEC Regional Meeting on the Resolution and Plan of Action for ASEAN Region Towards 2030 (10-11 September 2019, Bangkok, Thailand)

Achievements: Monitoring and enhancing awareness on international fisheries-related issues
The ASEAN-SEAFDEC member countries had the opportunity to discuss and develop common/coordinated positions that had been reflected at relevant international fora, especially those on the issues that could impact on fisheries development of the region, which was made possible through the SEAFDEC Project "**Assistance for Capacity Building in the Region to Address International Fish Trade-related Issues.**" Specifically the Project facilitated the development of the following outputs: • **2013:** ASEAN-SEAFDEC Common/Coordinated Positions Addressed at the CITES-CoP16 on the proposed listing of commercially-exploited aquatic species into the CITES Appendices and the proposed amendment of the rule of procedure on secret balloting (developed through the ASEAN-SEAFDEC Regional Consultation on Common/Coordinated Position of the Commerciall-exploited Aquatic Species at the CITES-CoP16, 23 January 2013, Bangkok, Thailand)

- **2016:** ASEAN-SEAFDEC Countries' Positions on Inclusion of the Commercially-exploited Aquatic Species (CEAS) addressed at the CITES Appendix at CoP-17 (developed through the Expert Meeting on Assessment of the Proposed Listing Commercially Exploited Aquatic Species to the CITES Appendix, 16-17 May 2016, organized back to back with the Regional Consultation for Development of the Common Position on the Proposed Listing Commercially Exploited Aquatic Species to the CITES Appendix, on 19-20 May 2016)
- **2018:** Summary of Gaps and Issues raised at the Thirty-third Session of COFI (developed through the Regional Technical Consultation on International Fisheries Related Issues, 20-22 June 2018, Bangkok, Thailand)
- **2019:** Positions of the ASEAN-SEAFDEC Member Countries on the Proposed Listing of Commercially-exploited Aquatic Species into the CITES Appendices at the CITES-CoP18 (developed through the Regional Consultation for Development of the ASEAN-SEAFDEC Common Position on the Proposed Listing of Commercially-exploited Aquatic Species into the CITES Appendices," 30-31 January 2019, Bangkok, Thailand)

5.2 Integration of gender in fisheries sector

SEAFDEC had embarked on several activities toward gender mainstreaming with a view to promoting gender in fisheries and ensuring that women and men gain equal benefits from fisheries management programs and projects. At the outset, a Gender Focal Person from SEAFDEC/TD was designated and trained to spearhead the activities that focused on capacity building of the whole SEAFDEC staff on gender concepts. Meanwhile, research programs were also conducted to understand the gender context in fishing communities, the results of which were used as guide for the fisheries management projects on gender integration in fisheries. In 2019, SEAFDEC continued its momentum on gender mainstreaming by designating the respective SEAFDEC Gender Focal Persons (SGFP) for the SEAFDEC Secretariat and Departments. The activities on gender mainstreaming at SEAFDEC were also strengthened with support from three projects, *i.e.* the Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia (SEAFDEC-Sweden Project), the Oceans and Fisheries Partnership (USAID Oceans), and the Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand.

To sustain the gender mainstreaming in SEAFDEC as an organization, the SEAFDEC-Sweden Project supported the development of the "SEAFDEC Gender Strategy," which was initiated in 2018 and approved by the SEAFDEC Council at its 51st Meeting (18-22 March 2019, Surabaya, Indonesia). Subsequently, the "Workshop on the Development of the Action Plan for SEAFDEC Gender Strategy" was organized by SEAFDEC which came up with the Action Plan for the SEAFDEC Gender Strategy, the common key indicators to monitor and evaluate the implementation of the Gender Strategy, and the revised Terms of Reference for SGFPs. The SEAFDEC-Sweden Project also supported the development of the "Practical Guide for Gender Analysis in Small-scale Fisheries and Aquaculture in Southeast Asia" to be used by program/project managers, researchers, and fishery officers of the countries in Southeast Asia and fisheries-related organizations including SEAFDEC to support the formulation of programs/projects that are gender-sensitive and/or gender-responsive as appropriate. *(see 7.1, under Addressing cross-cutting issues)*

Under the USAID Oceans Project, the work stream was undertaken through the Project Technical Working Group (TWG) on Human Welfare, Gender and Labor. Through the Project, SEAFDEC had provided interventions through the series of activities in 2019 at learning sites with a view to promoting gender equity. Meanwhile, the lessons learned on gender integration in fisheries through the experiences of SEAFDEC and USAID Oceans were also shared through various events. *(see 7.2, Objective 4: Address and strengthen capacity for human welfare, including gender and labor across all program activities)*

As for the Fisheries *Refugia* Project, the "Training of Trainer for Key Persons on Gender Mainstreaming in Fisheries *Refugia* Management" was organized on 17-18 June 2019 in Kampot Province, Cambodia, which is one of the Fisheries *Refugia* Project sites. Through such capacity building on gender analysis, better understanding was gained by concerned stakeholders in fishing communities of the gender concepts, while the output could be utilized as basis for gender integration in fisheries management.

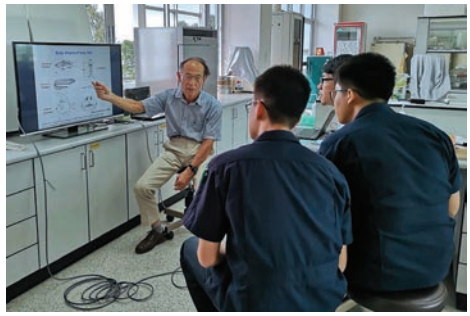
6. Strategy VI: Empowering SEAFDEC to strengthen its roles in the region and to improve its services to Member Countries

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

The M.V. SEAFDEC 2 has been utilized by TD 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. This had been facilitated through the Project "**Fisheries Resource Survey and Operational Plan for M.V. SEAFDEC 2.**" In 2018, the "Collaborative Research Survey on Marine Fisheries Resources and Marine Environment in the Gulf of Thailand" was conducted by TD in collaboration with Cambodia, Thailand, and Viet Nam, using the M.V. SEAFDEC 2.

The results and recommendations of the 2018 Collaborative Research Survey in the Gulf of Thailand were discussed during the "Regional Technical Meeting on the Evaluation of the Collaborative Research Survey on Marine Fisheries Resources and Marine Environment in the Gulf of Thailand." Organized by TD on 8-9 of January 2019 at its premises in Samut Prakan, Thailand, the Meeting analyzed the findings of the Collaborative Research Survey, providing the platform for setting-up of the timeframe and follow-up actions for the samples and data analysis, as well as discussing the information and data sharing schemes as well as the required human resource development program in the future.

Sea trial of mid-water trawl in Sarawak Waters, Malaysia conducted from 5 to 29 September 2019



Japanese expert on fish early life history science, Dr. Yoshinobu Konishi served as the advisor on the identification of fish larvae samples

Furthermore, TD also supported the DOF Malaysia during the conduct of "Sea trial of Mid-water Trawl Using the M.V. SEAFDEC 2 in the Waters of Sarawak in East Malaysia" on 5-29 September 2019. Based on the composition of catch harvested from the mid-water trawl fishing operations, it was concluded that the use of mid-water trawl in Malaysian waters is feasible. During the cruise, operation of the automatic squid jigging machine was also demonstrated for 15 researchers and staff of DOF Malaysia who joined the cruise.

TD also provided technical support to the DOF of Thailand in through the collaborative research survey between the Government of Thailand and Timor Leste using the DOF research vessel, the R.V. CHULABHORN. During the said research survey in the EEZ of Timor Leste, concerned researchers from TD participated in the survey cruise which was organized from 28 May to 27 July 2019.

Moreover, as marine debris and in particular plastic debris in the sea has recently become a global concern as expressed during several international fora, TD with technical support from Tokyo University of Marine Science and Technology (TUMSAT) of Japan, and Chulalongkorn University and Burapha University of Thailand, conducted the "Regional Training on Marine Debris Research Survey by Research Vessel" from 27 November to 2 December 2019 at the premises of TD. The Training was aimed at enhancing the human resources capacity on marine debris and related subjects, and strengthening the network of scientists/researchers on marine debris and microplastics in the Southeast Asian region. Information on the present status of marine debris in Southeast Asia was also shared and discussed. After the Training, SEAFDEC facilitated the conduct of marine debris research survey in the Gulf of Thailand from 29 November to 21 December 2019, participated by 35 researchers from the Southeast Asian countries.

Regional Training on Marine Debris Research Survey by Research Vessel (27 November - 2 December 2019 at SEAFDEC TD)

6.2 Enhancing coordination and networking with the Member Countries

SEAFDEC continued to enhance its coordination and networking with the ASEAN-SEAFDEC Member Countries through the Project "**Strengthening SEAFDEC Network for Sustainable Fisheries,**" which has been instrumental in maintaining the "Regional Fisheries Policy Network (RFPN)." Established in 2006 with members being seconded from the AMSs to the SEAFDEC Secretariat for a period of one year, the RFPN serves as conduit between and among SEAFDEC and the Member Countries. For 2019, the RFPN comprised seven Fisheries Officers from Cambodia, Indonesia, Lao PDR, Myanmar, Philippines, Thailand, and Viet Nam, four of whom were supported by the SEAFDEC-Sweden Project, and three by the Japanese Trust Fund. 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 respective countries' commitments for the implementation of the Resolution and Plan of Action.

Back row from left: Regional Fisheries Policy Network Members for Lao PDR, Myanmar, Indonesia, and Thailand; and front row from left: RFPN Members for Viet Nam, Philippines, and Cambodia

Moreover, the Project also facilitated continued coordination with the ASEAN, especially serving as channel for SEAFDEC in relaying the results of its activities in line with the priority and policy frameworks endorsed by the ASEAN, as well as submission of policy documents

developed through SEAFDEC initiatives for endorsement under the ASEAN mechanism. The partnership established with the ASEAN through the Project also enhanced the participation of SEAFDEC in several fisheries-related meetings of the ASEAN in 2019, *i.e.* the 11th Meeting of the ASEAN Fisheries Consultative Forum (AFCF) (25-26 June 2019, Da Nang, Viet Nam); and the 27th Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGFi) (27-29 June 2019 in Da Nang, Viet Nam). During these meetings, the progress made by SEAFDEC in the implementation of ASEAN fisheries-related policies were also reported.

Other significant progress made in 2019 was the adoption of two policy documents by ASEAN Ministers on Agriculture and Forestry (AMAF). These are: the "Regional Guidelines on Cold Chain Management for Seafood," and the "Regional Technical Guidelines on Early Warning System for Aquatic Animal Health Emergencies." Another policy framework document, the draft "Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2030" was being developed and once finalized, this would be submitted for consideration by the SEAFDEC Council and the ASEAN authorities in 2020. *(see 5.1 Monitoring and enhancing awareness on international fisheries-related issues)*

Outgoing SEAFDEC Secretary-General Dr. Kom Silapajarn (seated second from the right) *attending the 27th Meeting of the ASWGFi (27-29 June 2019 in Da Nang, Viet Nam)*

Through the Project, dissemination of results of the activities carried out by SEAFDEC and the Member Countries in line with the Resolution and Plan of Action had been sustained through the SEAFDEC Special Publication "Fish for the People." Three issues of the publication bearing the following corresponding themes: 1) Equating enhanced sustainability in fisheries with secured trade: Southeast Asia on the hub; 2) Tipping the scales for sustainable fisheries in Southeast Asia; and 3) Advancing sustainable fisheries management in Southeast Asia, were published and disseminated in 2019.

Three issues of SEAFDEC Special Publication published in 2019

7. Special Projects

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

The 7-year Project "Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia" had been implemented by SEAFDEC with the financial support from the Swedish Government since 2013 and reached its final year in 2019. Also known as the SEAFDEC-Sweden Project, it has the overall objective of achieving sustainable use of aquatic resources and reducing vulnerability to climate change by fishing communities in the ASEAN Member States (AMSs). The Project carried out activities towards achieving three output objectives:

Output objective 1	Capacity built for integration of fisheries and habitat management and adaptation to climate change
Output objective 2	Capacity built and system improved for the management of fishing capacity (monitoring, record and control)
Output objective 3	Capacity built and policy development process improved for the drafting and implementation of regional and sub-regional agreements

In addition, several cross-cutting issues had also been addressed through the Project. These include those that pertain to gender and labor aspects, local capacity-building, diversifying livelihoods, enhancing the social well-being, and strengthening the cooperation among the concerned countries.

Geographically, the Project covers four sub-regions in Southeast Asia, namely: the Andaman Sea, Gulf of Thailand, Mekong River Basin, and the Sulu-Sulawesi Seas. In 2019 however, specific sub-regional focus was given to strengthening of the cooperation around the Gulf of Thailand and Andaman Sea. As 2019 was the last year of the Project, series of events were successfully conducted and concluded with significant achievements, *e.g.* sustainable management of neritic tunas and other transboundary aquatic resources/ stocks, establishment of MCS networks, strengthening gender integration in the fisheries sector, addressing the importance of small-scale fisheries.

Output objective1: Capacity built for integration of habitat and fisheries management and adaptation to climate change

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

To continue the tasks spelled out in the "Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region" adopted by the SEAFDEC Council in 2015, the SEAFDEC-Sweden Project organized on 9-11 January 2019, the "Fifth Meeting of the Scientific Working Group on Neritic Tunas (SWG-Neritic Tunas)" in Bangkok, Thailand, where the results of the stock status and risk assessments of the Indo-Pacific king mackerel (*Scomberomorus guttatus*) and narrow-barred Spanish mackerel (*Scomberomorus commerson*), as well as the results of the genetic study of longtail tuna (*Thunnus tonggol*) in the Southeast Asian waters, were reported. The Meeting also developed the workplan for 2020 even if the

SEAFDEC-Sweden Project is scheduled to be completed in 2019, and noted that the future activities under the RPOA-Neritic Tunas and the SWG-Neritic Tunas would be continued under the responsibility of SEAFDEC/MFRDMD with support from other funding sources including grants under the ASEAN framework in cooperation with the ASEAN Working Group on Tuna, among others. The recommendations of the Fifth Meeting of the SWG-Neritic Tunas were reported to the 51st Meeting of the SEAFDEC Council in March 2019 organized in Indonesia, and subsequently to the 27th Meeting of ASWGFi on 27-29 June 2019 in Da Nang, Viet Nam.

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

In 2019, activities relevant to the management of transboundary aquatic resources/stocks through sub-regional approaches focused specifically on the resources in the Gulf of Thailand Sub-region. The SEAFDEC-Sweden Project in collaboration with SEAFDEC/UNEP/GEF Fisheries *Refugia* Project co-organized on 12-13 September 2019 in Chonburi Province, Thailand, the "Technical Consultative Meeting on Drafting of the Regional Action Plan for Management of Transboundary Species: Indo-Pacific Mackerel (*Rastrelliger brachysoma*) in the Gulf of Thailand Sub-region". With the participation of representatives from countries in the Gulf of Thailand and South China Sea Sub-regions, *i.e.* Cambodia, Indonesia, Malaysia, Philippines, Thailand, and Viet Nam, the Meeting came up with the Draft "Regional Action Plan for Management of Transboundary Species: Indo-Pacific Mackerel in the Gulf of Thailand Sub-region." The Draft Regional Action Plan was submitted to the 42nd PCM Meeting held in November 2019 in Chiang Mai, Thailand, and after initial discussion on the Draft, the Meeting agreed to endorse the draft Regional Action Plan to the Fifty-second Meeting of the SEAFDEC Council for consideration and support.

*Technical Consultative Meeting on Drafting of the Regional Action Plan for Management of Transboundary Species: Indo-Pacific mackerel (*Rastrelliger brachysoma*) in the Gulf of Thailand Sub-region (12-13 September 2019, Chonburi, Thailand)*

Achievements: Management of transboundary resources/stocks
On management of fisheries and their habitats: • The concerned countries in the Gulf of Thailand (GOT) and Andaman Sea (AS) sub-regions were able to enhance their capabilities through their participation in the studies on determining the stock status of transboundary species in the GOT and AS.

- Officers from the AMSs were able to build their capacities and raise their understanding of the concept of an Ecosystem Approach to Fisheries Management (EAFM) that aims for improved management of fisheries and habitat integration, and improved capacity and awareness of the fisheries and habitat integration at local levels.

On neritic tunas:

- The AMSs were able to develop the "Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region (RPOA-Neritic Tunas)" which was adopted by the SEAFDEC Council in 2015, and established the "Scientific Working Group on Stock Assessment for Neritic Tunas in the Southeast Asian waters (SWG-Neritic tunas)," through the sustained support of the SEAFDEC-Sweden Project.
- Researchers from the AMSs were also trained on data collection and analysis on neritic tunas, and stock assessment of various neritic tuna species in the Pacific and Indian Oceans, namely: longtail tuna (*Thunnus tonggol*), kawakawa (*Euthynnus affinis*), Indo-Pacific king mackerel (*Scomberomorus guttatus*), and narrow-barred Spanish mackerel (*Scomberomorus commerson*), following the "Standard Operating Procedure (SOP) for Data Collection and Analysis of the Neritic Tunas."
- The genetic study for longtail tuna in the South China Sea, Gulf of Thailand, and Andaman Sea based on the "SOP for Collection and Preservation of DNA Tissue Samples," was pursued through the continued support from the Project.
- The results from such data collection and studies which revealed the actual status of the neritic tuna species in the GOT and AS could be used as basis for the development of scientific-based recommendations that support the management of fisheries of the species in the Pacific and Indian Oceans.

Other transboundary aquatic species (GOT):

- The "Standard Operating Procedures (SOP)" was developed for data collection of transboundary species, focusing on the Indo-Pacific mackerels, anchovies and blue swimming crab, considering that these are the priority transboundary species in the Gulf of Thailand Sub-region (involving Cambodia, Malaysia, Thailand, and Viet Nam).
- Based on the results of the data collection coupled with DNA collection and analysis, the stock status of these species in Cambodia, Viet Nam, Thailand, and Malaysia was established, but revealing the mixed stock structure of the Indo-Pacific mackerels in the Gulf of Thailand Sub-region.
- The "Regional Action Plan for Management of Transboundary Species: Indo-Pacific Mackerel in the Gulf of Thailand Sub-region," was finalized and is expected to serve as basis for countries to continue the studies on these economically important transboundary species and collaboration in the future.

Other transboundary aquatic species (AS):

- Countries in the Andaman Sea Sub-region (involving Myanmar, Thailand, Malaysia, and Indonesia), were able to discuss and review the available data of the priority transboundary species, namely: anchovies, mackerels and neritic tuna
- Researchers from the concerned countries came up with digital maps indicating the spawning grounds, spawning seasons, biological characteristics, habitats and migration patterns, as well as existing fishing regulations on the said transboundary species.

On Ecosystem Approach to Fisheries Management:

- About 200 participants from Cambodia, Myanmar, Thailand, and Lao PDR received training on the adoption of Ecosystem Approach to Fisheries Management (EAFM) through the series of on-site training programs on Essential Ecosystem Approach to Fisheries Management (E-EAFM) and Training of Trainers on E-EAFM organized by the Project.
- The Project's local partners strengthened the promotion of habitat restoration and fishery resources enhancement, and boosted the awareness and appreciation of stakeholders on the importance of sustainable management practices and judicious utilization of fishery resources that ensure the security and sustainability of their livelihoods.

Output objective 2: Capacity built and system improved for the management of fishing capacity (monitoring, record and control)

The activities were focused on strengthening of the sub-regional and bi/trilateral MCS networks in the Gulf of Thailand and Andaman Sea Sub-regions.

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

In order to strengthen the sub-regional cooperation on Monitoring, Control and Surveillance (MCS), the SEAFDEC-Sweden Project organized the "Gulf of Thailand Sub-Regional Monitoring, Control and Surveillance (MCS) Network Meeting" on 20-21 June 2019 in Chonburi Province, Thailand, and the "Meeting on Development of Monitoring, Control and Surveillance Network for Southern Andaman Sea Sub-region" on 20-21 August 2019 in Bangkok, Thailand. Considering the common concerns expressed by the countries in the Gulf of Thailand and Southern Andaman Sea, the two Meetings came up with list of information that should be shared and coordinated among the AMSs for enhancing the future cooperation on the MCS components of the respective sub-regions. The Meetings also discussed the working mechanisms and the ambitions for future MCS Coordination Group or Network, the results of which had been used as inputs for the preparation of an initial Concept Paper for further discussion and confirmation later. In addition, the participating countries agreed to establish single point of contact (SPOC) for GOT countries using the same focal point network as that of the RPOA-IUU, while encouraging the participation of Myanmar and Lao PDR in the RPOA-IUU events and other regional meetings, and other SEAFDEC and ASEAN mechanisms for strengthening the MCS Networks.

Group discussion during the Gulf of Thailand Sub-Regional Meeting on Monitoring, Control and Surveillance (MCS) Network (20-21 June 2019, Chonburi, Thailand)

Participants of the Meeting on Development of Monitoring, Control and Surveillance Network for Southern Andaman Sea Sub-region (20-21 August 2019, Bangkok, Thailand)

The establishment of the MCS Networks during the course of the project implementation in 2019 was also made possible through the active participation of national and regional partners such as the ASEAN, RPOA-IUU, International Monitoring, Control and Surveillance Network, FAO, SEAFDEC/Japanese Trust Fund, Sustainable Management of Highly Migratory Fish Stocks in the West Pacific and East Asian Seas (WPEA-SM Project) under the Western and Central Pacific Fisheries Commission (WCPFC).

Achievements: Management of fishing capacity and combating IUU fishing

The AMSs had the opportunity to discuss and agree among the countries the development of solutions for addressing overcapacity and IUU fishing through the sub-regional and bilateral dialogues facilitated by the SEAFDEC-Sweden Project. These include:

- The "Regional Plan of Action on Management of Fishing Capacity (RPOA-Capacity)," which had been developed and promoted to serve as guide for the AMSs in their efforts towards the sustainable utilization of fishery resources in their respective waters
- Monitoring, Control and Surveillance (MCS) Networks had been established at the sub-regional levels through strengthened inter-agencies coordination in the Gulf of Thailand and Andaman Sea Sub-regions
- Development of the electronic ASEAN Catch Documentation Scheme (eACDS) and other initiatives of SEAFDEC to combat IUU fishing
- Implementation of the Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (PSMA) in the AMSs, with a view to prevent the entry of IUU fishing products into the region's supply chain

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

Gulf of Thailand Sub-region: the SEAFDEC-Sweden Project supported the "Eighth Meeting of the Gulf of Thailand Sub-Region" on 4-5 September 2019 in Chonburi Province, Thailand, which reviewed the recommendations from previous meetings related to the Project and discussed the progress of the activities. The Meeting also reviewed the steps taken to strengthen the cooperation on transboundary fisheries and habitat management options including potential actions for continuing operations at the sub-regional level, strengthened sub-regional MCS Network cooperation, and recommended further actions for sustaining the GOT Sub-region meeting platform. During the Meeting, the participating countries, namely: Cambodia, Malaysia, Thailand, and Viet Nam, were updated on the progress of the management of fishery resources (*e.g.* Indo-Pacific mackerel, neritic tunas), national laws, regulations, and actions for fisheries management, and on strengthening of the MCS network in the Gulf of Thailand Sub-region. The countries also reaffirmed the importance of the GOT sub-regional platform, and expressed the willingness to continue such mechanism in the sub-region after the completion of SEAFDEC-Sweden Project.

Eighth Meeting of the Gulf of Thailand Sub-Region (4-5 September 2019, Chonburi, Thailand)

Andaman Sea Sub-region: the Project facilitated the discussions on several areas of mutual interest among the countries in this Sub-region, namely: Thailand, Myanmar, Indonesia, and Malaysia, including the aspects on management of transboundary stocks, combating IUU fishing, and the establishment of MCS coordination effort for Northern and Southern Andaman Sea sub-regions. The information and key achievements derived from the Project had been shared with FAO, to serve as inputs in the formulation of the project "Sustainable management of fisheries, marine living resources and their habitats in the Bay of Bengal region for the benefit of coastal states and communities" which is expected to commence by the end of 2020 with FAO/GEF as the prospective funding agency. Through this FAO project, the initiatives in strengthening the cooperation among the countries in the Andaman Sea Sub-region could be sustained.

Achievements: Sub-regional cooperation
The sub-regional cooperation which had been promoted by SEAFDEC since early 2000s had been fostered by the SEAFDEC-Sweden Project through: • Series of meetings organized to serve as platforms for discussion among the countries in the Gulf of Thailand and the Andaman Sea Sub-regions, as well as bilateral dialogues among countries in these sub-regions • Strengthened cooperation among the concerned countries led by Thailand to address IUU fishing concerns in the sub-regions, resulted in subsequent signing of more Memorandums of Understanding between and among the concerned countries, *e.g.* Thailand-Cambodia, Thailand-Lao PDR, and Thailand-Myanmar, Thailand-Viet Nam (negotiations ongoing), Thailand-Malaysia (negotiations ongoing) • With existing MOUs (*i.e.* Cambodia-Viet Nam, Cambodia-Lao PDR) signed in 2014, bilateral dialogues between Cambodia and Viet Nam, and Cambodia and Lao PDR in 2014-2016 facilitated the development of the workplan for the comparative study of the laws and regulations of these concerned countries

Addressing cross-cutting issues

o Gender and Social Development

In 2019, the SEAFDEC-Sweden Project continued to work on the integration of gender in project implementation, provide for institutional capacity building on gender integration at SEAFDEC, and enhance the cooperation with other partners toward the promotion of gender equality in the fisheries sector.

Since 2018, the Project supported the development of the "Practical Guide for Gender Analysis in Small-Scale Fisheries and Aquaculture in Southeast Asia" using as framework, 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)." To finalize the draft Practical Guide, the Project organized the "Experts Consultation Workshop on Finalization of the Practical Guide for Gender Analysis in Small-Scale Fisheries and Aquaculture in Southeast Asia" on 10-11 July 2019 at SEAFDEC/TD in Samut Prakan, Thailand. The Workshop came up with the final draft Practical Guide that compiles the available tools and procedures that could be used for gender analysis, together with guide questions, examples of gender-sensitive indicators, and methods for data analysis. This Practical Guide could be used as tool to support the AMSs in integrating gender and social well-being in the entire cycle of their respective programs and projects to achieve the sustainability of the fishery resources and eradicate poverty in small-scale fishing communities.

The SEAFDEC-Sweden Project had also supported the development of the "SEAFDEC Gender Strategy" that strives to mainstream and integrate gender perspectives into the SEAFDEC organization, and in its programs, projects, and activities. After the approval of the SEAFDEC Gender Strategy by the SEAFDEC Council at its 51st Meeting in Indonesia in March 2019, the Project also supported the conduct of the "Workshop on the Development of the Action Plan for SEAFDEC Gender Strategy" on 9 July 2019 at SEAFDEC/TD in Samut Prakan, Thailand, with the participation of SEAFDEC Gender Focal Persons from the SEAFDEC Secretariat, TD, AQD, MFRDMD, and IFRDMD. The Workshop agreed on the common action

plan and key indicators to facilitate the monitoring and evaluation of the implementation of the SEAFDEC Gender Strategy, and the mechanism for reporting of the progress in the implementation of the SEAFDEC Gender Strategy in the future.

Experts Consultation Workshop on Finalization of the Practical Guide for Gender Analysis in Small-Scale Fisheries and Aquaculture in Southeast Asia (10-11 July 2019, Bangkok, Thailand)

Approval of the SEAFDEC Gender Strategy by the SEAFDEC Council at its 51st Meeting in March 2019

o Support to local capacity building

Throughout its duration, the SEAFDEC-Sweden Project collaborated with a number of local partners, *e.g.* the Learning Institute (Cambodia), CORIN-Asia Cambodia, and Sustainable Development Foundation (SDF) Thailand, for the implementation of the Project activities at the local community levels. The lessons learnt from the implementation of the activities by the SDF were shared during the "National Forum to Share Lessons Learned and Knowledge of Fisheries Communities on Fisheries Resources and Habitat Management" on 6-8 August 2019 in Chanthaburi and Trat Provinces, Thailand. The lessons learned from the local activities carried out in Cambodia in 2018 were also shared during the said National Forum which was attended by about 120 participants from various organizations, communities, including the youth and researchers from universities and also 10 participants from Cambodia. As the sharing of experiences and lessons learned from the activities implemented at the local level was facilitated, the awareness of other relevant organizations/sectors and the youth on coastal community's livelihoods and fisheries, and coastal ecosystem, was also enhanced. The National Forum was divided into sessions to discuss the topics on fisheries and habitat management approach and small-scale fisheries of Trat Bay, climate change mitigation, local network on fisheries and habitat management, gender in fisheries, and research for communities. Moreover, the experiences gained by the Learning Institute and CORIN-Asia Cambodia from implementing the local activities were also shared during the National Forum. The relationship among relevant government agencies, organizations, academic institutes, and local communities in Thailand and Cambodia, was therefore fostered.

Sharing of lessons learned and experiences gained by fisheries communities on fishery resources and habitat management during the on-site activities in Trat Province, Thailand

Enhanced Coordination among the AMSs through the Regional Fisheries Policy Network

In 2019, the SEAFDEC-Sweden Project supported four (4) officers from national fisheries agencies of the AMSs, namely: Indonesia, Myanmar, Thailand and Philippines, stationed at the SEAFDEC Secretariat for one year, while three (3) officers from Cambodia, Lao PDR and Viet Nam were supported by the Japanese Trust Fund. Throughout the year, the officers who comprised the 2019 Members of the Regional Fisheries Policy Network (RFPN) played active role in enhancing the coordination and communication between SEAFDEC and their respective countries, while also being given the opportunity to attend and provide technical contributions during the various events organized by SEAFDEC.

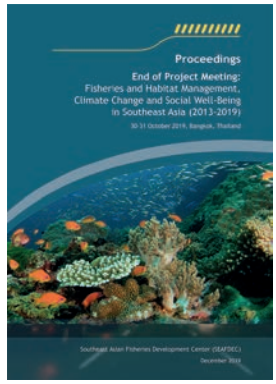
Coordination with other organizations and projects

The SEAFDEC-Sweden Project supported the joint activities and coordination with the ASEAN and several regional and international organizations, and other projects with the aim of enhancing regional cooperation and ensuring long-term sustainability of marine and inland aquatic resources. Regional cooperation among the AMSs, *e.g.* through joint regional, sub-regional and bilateral approaches, is also crucial in building-up and promoting their common understanding in securing sustainability of the fishery resources bearing in mind the "transboundary" nature of several aquatic resources including the mobility of fishers that utilize such resources. The Project therefore facilitated sub-regional cooperation and initiatives during regional and sub-regional consultations/events (*i.e.* for the Gulf of Thailand and Andaman Sea) as well as in the implementation of regional policy frameworks, such as the Regional Plans of Action, such as the RPOA-IUU, the RPOA-Neritic Tunas and the RPOA-Fishing Capacity.

In 2019, the Project coordinated closely with several organizations and projects, particularly with the FAO Headquarters in Rome and Regional Office in Bangkok, the Asia-Pacific Fisheries Commission (APFIC), and the Secretariat of the Regional Plan of Action to Promote Responsible Fishing Practices including Combating IUU Fishing (RPOA-IUU). The Project also shared information on its activities with several organizations and projects such as USAID, IUCN, International Labour Organization (ILO), SEAFDEC/UNEP/GEF/Fisheries *Refugia* Project, SEAFDEC/Japanese Trust Fund (JTF).

End-of-Project Meeting of the SEAFDEC-Sweden Project: Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia Project (2013-2019)

Towards the completion of the SEAFDEC-Sweden Project, SEAFDEC convened the two-day "End-of-Project Meeting of the SEAFDEC-Sweden Project: Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia Project (2013-2019)" on 30-31 October 2019 in Bangkok, Thailand. The Meeting gathered about 80 participants from the AMSs, namely, Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, and Viet Nam; and representatives from the Embassy of Sweden in Bangkok, Thailand, and relevant regional organizations and projects. The participants and stakeholders involved through the Project implementation also attended the Meeting and shared their experiences and the lessons learned under the thematic areas on: 1) transboundary fishery resources; 2) regional and sub-regional cooperation for the management of fishing capacity and combating IUU fishing; 3) livelihoods diversification and adaptation to climate change for poverty alleviation; 4) gender integration in fisheries; and 5) sub-regional platforms. The shared experiences, best practices, lessons learned from the implementation of the Project, and the recommendations from the participants were distilled into a set of Key Messages that serve as guidelines for SEAFDEC, ASEAN, Governments of the AMSs, and the partner organizations for building on the results and sustaining the initiatives of the Project.



End-of-Project Meeting of the SEAFDEC-Sweden Project: Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia Project (2013-2019)

7.2 Oceans and Fisheries Partnership

Launched in 2015, the **USAID Oceans and Fisheries Partnership** or "USAID Oceans" has been implemented by Tetra Tech ARD with SEAFDEC and the Coral Triangle Initiative on Coral Reefs Fisheries and Food Security (CTI-CFF) as regional partners. The USAID Oceans is aimed at strengthening regional cooperation to combat illegal, unreported, and unregulated (IUU) fishing; promoting sustainable fisheries; and supporting the conservation of marine biodiversity in the Asia-Pacific region. In support of this objective, USAID Oceans built regional cooperation and capacity to combat IUU fishing and conserve marine biodiversity; supported the development and expansion of financially sustainable eCDT technologies in priority marine biodiversity areas where sustainable fisheries management plans (SFMPs) were developed and implemented; strengthened human and institutional capacity of regional, national, and local organizations to use an ecosystem approach to fisheries management (EAFM); raised the awareness and strengthened capacity to address human welfare and gender equity concerns within fishery supply chains; and established public and private partnerships (PPPs) to combat IUU fishing and seafood fraud and promote sustainability. The major activities and achievements of USAID Oceans in 2019 include the following:

Strengthening of regional cooperation and national capacity to combat IUU fishing and promote fisheries sustainability

USAID Oceans continued to coordinate closely with the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) and Indonesia's Ministry of Marine Affairs and Fisheries (MMAF) on the national implementation of eCDT systems, including working closely with private sector partners at the General Santos City and Bitung learning sites in the Philippines and Indonesia, respectively. USAID Oceans also engaged other interested countries in Southeast Asia (*i.e.* Malaysia, Thailand, and Vietnam) to support their development, testing, and implementation of the eCDT technologies.

USAID Oceans' technology partners update the eCDT systems in the program's learning site in the Philippines

SEAFDEC- USAID Oceans' Indonesia Partnership Transition Workshop (25-26 November 2019, Bitung and Manado Indonesia)

Moreover, the draft "Technical Guidance on the Design and Implementation of eCDT Systems in Southeast Asia" was developed through a series of national consultations and regional workshops with participating countries, which culminated with the final "USAID

Oceans/SEAFDEC Regional Workshop to Review and Finalize the Regional eCDT Technical Guidance Document" on 2-4 December 2019 in Bangkok, Thailand. When finalized in early 2020, this Technical Guidance will serve as a regional reference for technology standards, requirements, and processes for the adoption, implementation, and sustained use of the eCDT systems across interested AMSs. In addition, a series of eCDT technology showcase events were conducted in several countries in the region during 2019 to share the available eCDT technology solutions, including SEAFDEC's eACDS system, with interested governmental and non-governmental stakeholders. Such regional events allowed national and regional partners to share their experiences and lessons learned from the development, testing, and implementation of various eCDT technologies (hardware and software) with the AMSs.

Participants at USAID Ocean's Regional eCDT Workshop in Bangkok

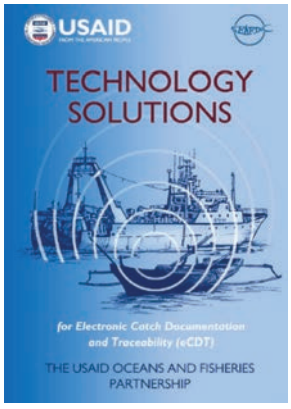
As one of USAID Oceans' "expansion" countries beyond Indonesia and the Philippines, Thailand partnered with USAID Oceans in 2019 to convene the "Workshop to Review Available eCDT Technology Solutions" on 14-16 May 2019 in Bangkok, Thailand. This Workshop assessed opportunities to advance Thailand's fishery traceability systems, shared national lessons learned on the development and implementation of eCDT systems, and gathered national feedback on the Technical Guidance document. Subsequently, a "Fisheries Value Chain Analysis Workshop" was convened by the DOF of Thailand and USAID Oceans on 31 October 2019 in Bangkok, Thailand to discuss and identify relevant data that should be captured at each node in the fishery supply chain; identify the benefits that these data would provide to the government and private sector; discuss how to encourage data collection, validation, and integration throughout the supply chain; and determine the ways in which available eCDT technologies can address human welfare concerns associated with the fishing industry. Findings from the workshop are being analyzed by the DOF of Thailand to inform the priority next steps for supporting Thailand in the development and implementation of an efficient eCDT system for small-scale fisheries.

Participants of the USAID Oceans' Thailand eCDT Workshop include government representatives, members of the private sector, and SEAFDEC program partners

The Director of the Fish Inspection and Quality Control Division of the DOF of Thailand shares thoughts at a Value Chain Analysis Workshop

Supporting the development and expansion of financially sustainable eCDT systems in priority biodiversity areas where sustainable fisheries management plans (SFMPs) are being applied

In 2019, USAID Oceans convened multi-stakeholder consultative workshops to finalize the Sustainable Fisheries Management Plans (SFMPs) in partnership with national fisheries agencies in the Philippines and Indonesia. The finalized SFMPs identify the key management priorities and actions for critical Fishery Management Areas in both countries based on associated ecological, human, and governance conditions, in support of existing national fishery plans currently being implemented. In addition, USAID Oceans worked with the Regional Secretariat and the six member countries of CTI-CFF during 2019 to ensure the full adoption and implementation of the "Sub-Regional Ecosystem Approach to Fisheries Management (EAFM) Plan for the Sulu-Sulawesi Seas," which was formally endorsed by the six member countries during the CTI-CFF Senior Officials Meeting in late 2019.



USAID Oceans eCDT capstone

USAID Oceans' eCDT "capstone" product was also released in 2019 to complement the previously released thought leadership publications, providing an overview of USAID Oceans-supported eCDT technology solutions, including the SEAFDEC eACDS, currently available to the AMSs. In its eCDT learning sites in the Philippines and Indonesia, USAID Oceans continued supporting the private sector installation and testing of eCDT technologies, as well as the testing of live, in-field data with fishing industry and small-scale fisher-partners. Using the available eCDT technologies, over 2,000 metric tons of seafood at an import value of more than US $20 million was fully traced during 2019 throughout the supply chain—from point-of-catch to markets exporting to the United States. Furthermore, USAID Oceans supported the rollout of SEAFDEC's eACDS software, initially pilot tested in Brunei Darussalam, expanding during 2019 into Viet Nam and Malaysia. This support included procurement of the necessary hardware required for the pilot implementation of eACDS in Viet Nam in 2020.

Developing and strengthening human and institutional capacity of regional organizations to use EAFM

During 2019, USAID Oceans awarded two grants to non-governmental organizations in Indonesia and the Philippines to develop innovative technology solutions in support of EAFM at the learning sites in Bitung and General Santos City. The two grant recipients—Masyarakat Dan Perikanan Indonesia (MDPI) and Mindanao State University (MSU) Naawan Foundation for Science and Technology Development—began developing their Innovative Digital Solutions (IDS) in the form of mobile applications and desktop software dashboards. These technologies use live eCDT data to conduct real-time data analysis and visualization, in order to empower the decision making of local and national fisheries managers. Both digital solutions will be implemented with national governments during early 2020. Interested governmental and non-governmental organizations intend on adapting and using the digital solutions beyond Indonesia and the Philippines in the future, including within other Southeast Asian countries and other regions around the world beyond the life of the USAID Oceans project (ending May 2020).

Raising awareness and strengthening the capacity to address human welfare concerns, including gender equity, within fishery supply chains

In 2019, USAID Oceans engaged partners and technical specialists working to address Human Welfare and Gender Equity in fisheries through workshops and trainings at both learning sites in Indonesia and Philippines. These workshops included events that aim to engage the industry and government representatives in the development of gender guidelines and amended policies that strengthen gender equity, promote women's empowerment, and address other human welfare issues within high-value fishery supply chains. Specifically, the following events were conducted during 2019:

- *Inception and Planning Workshop Raising Awareness of Gender Equity and Women's Empowerment in Fisheries Management in General Santos and Sarangani Bay Area, Philippines* (21-23 February 2019, General Santos City, Philippines). The workshop aimed to obtain information from gender analyses in tuna fisheries value chains and gain participants' commitment to support the intervention on raising awareness of gender equity and women's empowerment in fisheries management in General Santos and Sarangani Bay Area, Philippines.
- *Capacity Development Training Workshop on Gender Analysis for Fisheries Management and Development in Mekong Region* (12-14 March 2019, Vientiane, Lao PDR). Members of USAID Oceans' Technical Working Group from countries of the Mekong region (Cambodia, Lao PDR, Myanmar, and Viet Nam) participated in this training, which aimed to increase their understanding of gender mainstreaming in different organizational levels, including integrating gender into the policy, structure, and culture of the organization.
- *Workshop on Gender Mainstreaming Roadmap in Marine and Fisheries Sector: Capacity Building on Gender Sensitivity and Responsiveness* (26-27 March 2019, Jakarta, Indonesia). The workshop was aimed at building the capacity on gender sensitivities and responsiveness through a review of the gender perspectives in marine and fisheries roadmap in Bitung, Indonesia.

- *Empowering Fisheries Officers for Gender-Responsive and Sustainable Fisheries Management* (25-26 April 2019, Iloilo City, Philippines). The event was aimed at conducting gender sensitive training among BFAR regional directors and regional planners, and included a review of BFAR's "Gender and Development" action plan to expand its implementation at the local level.
- *Workshop on Gender Concepts, Tools, and Advocacy in Sustainable Fisheries Management* (6-9 August 2019, Manado, Indonesia). The workshop aimed to build capacity and understanding of gender concepts and tools among stakeholders and partners for gender advocacy and promotion at the learning site. The event also included the development of work plans and strategies to be implemented as subsequent gender intervention activities.
- *Training on Financial Literacy and Management for Women in Fisheries* (24-25 September 2019, Bitung Indonesia). This training aimed to promote financial literacy among women involved in fisheries activities in Bitung and increase the capacity of women involved in fisheries (*i.e.* fishers, traders, processing plant workers) to manage financial resources.

Inception and Planning Workshop Raising Awareness of Gender Equity and Women Empowerment in Fisheries Management (23-24 February 2019, General Santos Philippines)

Workshop on Gender Mainstreaming Roadmap in Marine and Fisheries Sector: Capacity Building on Gender Sensitivity and Responsiveness (26-27 March 2019, Jakarta, Indonesia)

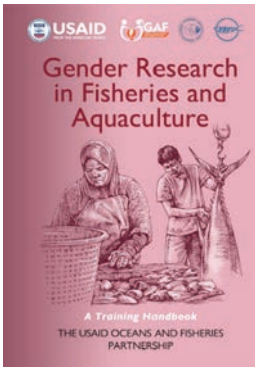
Empowering Fisheries Officers for Gender-Responsive and Sustainable Fisheries Management (25 to 26 April 2019, Iloilo City, Philippines)

Workshop on Gender Concepts, Tools, and Advocacy in Sustainable Fisheries Management (6-9 August 2019, Manado, Indonesia)

The publication "Gender Research in Fisheries and Aquaculture: Training Handbook" was finalized and released as a strategic capstone product during 2019 to build the capacity

of practitioners, experts, and students working in fisheries and aquaculture in gender theory and practice through interactive presentations and case studies. In partnership with SEAFDEC, two gender-in-fisheries-focused videos were also produced by USAID Oceans during 2019. USAID Oceans also awarded a grant to the National Network on Women in Fisheries in the Philippines, Inc. (WINFISH) to raise awareness of gender equity and promote women's empowerment in fisheries management at its learning site in General Santos City. In addition, gender interventions were conducted at both learning sites, while the lessons learned on gender integration in fisheries as well as experiences of SEAFDEC and USAID Oceans were shared during relevant events.

*SEAFDEC and USAID Oceans Gender Specialists pose with the USAID Oceans Contracting Officer's Representative at a gender training in Vientiane, Lao PDR. Credit: USAID Oceans/*A Satapornvanit



The publication "Gender Research in Fisheries and Aquaculture: Training Handbook"

Enhancing Public and Private Partnerships to combat IUU fishing and seafood fraud and promote fisheries sustainability.

The USAID Oceans Project continued to establish and support PPPs as part of the Project's cross-cutting objective. These partnerships, such as with several eCDT technology companies, as well as with regional partners, coordinate the partnership efforts across Southeast Asia. At the national level, USAID Oceans worked with private sector partners and NGOs in Indonesia during 2019 to finalize the design of and launch the new Indonesia Coastal Tuna Sustainability Alliance (ICTSA), which would serve as a leading industry voice in Indonesia to promote the growth of sustainable and traceable tuna fishery supply chains with overseas importers. USAID Oceans also explored potential partnerships with leading technology companies, such as IBM and Amazon Web Services, to support the program innovations and sustainability, as well as with national-based organizations such as Trinity Roots (Thailand), Marine Change (Indonesia), Marinelife Community Conservation and Development (Viet Nam), and World Wide Fund for Nature (Philippines) to support the expanded eCDT technology application beyond the two learning sites. By the close of 2019, over the life span of the USAID Oceans Project, US $3.8 million dollars had been leveraged from public and private sector partners in support of combating IUU fishing and promoting fisheries sustainability throughout Southeast Asia. The USAID Oceans Project will finish its regional and national programmatic activities in early 2020, followed by a formal closeout in May 2020.

SEAFDEC PROGRAMS FOR 2020

During the Forty-second Meeting of the SEAFDEC Program Committee (11-13 November 2019, Chiang Mai, Thailand), the programs and projects to be implemented by SEAFDEC in 2020 were scrutinized and endorsed. These programs/projects had been 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 list and description of programs and projects in 2020 appears as follow:

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. Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand (2016-2020) Implemented in six participating countries, namely: Cambodia, Indonesia, Malaysia, Philippines, Thailand, and Viet Nam, the Project aims to "operate and expand the network of fisheries *refugia* in the South China Sea and the Gulf of Thailand for improved management fisheries and critical marine habitats linkage." In 2020, Fisheries *refugia* profile reports including GIS maps and site characterizations would be published for 15 priority *refugia* sites. Also, the national reviews and recommendations for reforms of national, provincial and municipal regulations/ordinances for responsible fishing practices at priority *refugia* will be published, while characterizations for 15 *refugia* sites will be made accessible on-line. Awareness materials previously adopted will also be made available online, *i.e.* Standardized Methods for Collection and Analysis of Data and Information for the Use in Assessing the Impact of Fisheries *Refugia* and in the Designing of Appropriate Indicators for Long Term Management of the Regional System of Fisheries *Refugia*; Regional Action Plan for Management of Short Mackerel; and Regional Guidelines on Indicators for Management of Fisheries *Refugia*.	TD	UNEP/GEF
2. Strengthening the Effective Management Scheme with GIS (Geographic Information System) & RS (Remote Sensing) Technology for Inland Fisheries and Aquaculture at AMS (2019-2020) This project, which has been implemented since 2019 and will be completed in June 2020, aims to contribute to the effective management of inland fisheries and aquaculture in the AMSs through the use of GIS Mapping/RS technology to understand the relationship between environmental data and the amount of catch. In 2020, the Project would continue to collect catch data and consider the sources of satellites	SEC	JAIF

that provide suitable and reliable geographical/environmental information. The compiled data from fishing grounds would be clarified through multivariate analysis. The Project would come up with a manual on technical methods for analyzing catch and environmental data. In addition, a workshop would also be conducted to disseminate the analytical techniques using GIS mapping technology to the AMSs.		
3. Harmonization and Enhancing Utilization of Fishery Statistics and Information (2020-2024) The Project has the overall objective of enhancing the utilization of fishery statistics data and information for policy planning and management of fisheries toward sustainability. Under this Project, concerned staff from SEAFDEC will continue to participate in international meetings related to fishery statistics. In 2020 as the first year of this project, SEAFDEC Secretariat would conduct a Regional Technical Consultation among the AMSs to discuss the need to review/ revise the Regional Framework for Fishery Statistics of Southeast Asia, developed and used since 2008. Moreover, with a view to generating fisheries information that could support policy planning and management of fisheries, a meeting would be conducted among the concerned staff of the SEAFDEC Secretariat and Departments to discuss the contents of the publication "Southeast Asian State of Fisheries and Aquaculture" which is expected to be published in 2022. Meanwhile, the publication "Fish for the People" with 3 issues annually would also be sustained under the Project.	SEC	JTF
4. Responsible Fishing Technology and Practice (2020-2024) The Project aims to promote responsible fishing technologies and practices in Southeast Asia that minimize the impacts of fishing activities on the fishery resources and the marine ecosystems. In 2020, two regional technical meetings would be organized – one of which would aim to identify and gather information on environmental-impacted fishing gears and practices to the marine ecosystems, and the other one would focus on fuel consumption and safety in fishing operations. Furthermore, a regional training-of-trainers (ToT) would also be conducted on fish handing techniques onboard fishing vessels.	TD	JTF
5. Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region (2020-2024) The Project aims to work toward capacity development for the participating Member Countries, namely: Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand and Viet Nam, on taxonomy, new species/record identification, and management of major shark species; confirmation of stock structures for selected common species and CITES-listed species of sharks and rays; and development of socio-economic studies in selected sites using multifactor partitioning analysis. In 2020, a core experts meeting would	MFRDMD	JTF

be organized in Malaysia. SEAFDEC will also support shark data collection starting from 2020 until 2024 to obtain long-term landing data for estimating the stock and biomass using various models. Furthermore, a study would be undertaken on the stock structure of shark species, *i.e. Chiloscyllium hasseltii, Carcharhinus sorrah,* and *Sphyrna lewini*.		
6. Sustainable Utilization of Anguillid Eels in the Southeast Asian Region (2020-2024) The Project aims to sustain the sustainable management and utilization of anguillid eel fishery resources in the Southeast Asian region through the strategic program of sustainable eel resources management. In achieving sustainable eel fisheries and standardization of data collection system in Southeast Asia, surveys will be conducted in Indonesia and Philippines to collect catch and effort data as well as biological data. On genetic population structure of tropical eels in Southeast Asia, tissue samples would be collected in Indonesia, as well as in other countries, such as Philippines, Viet Nam and Myanmar. Laboratory work would also be conducted to analyze the genetic population structure of tropical anguillid eels.	IFRDMD	JTF
7. Sustainable Utilization of Fisheries Resources and Resources Enhancement in Southeast Asia (2020-2024) The Project aims to achieve improved technical capacities of human resources in the region in conducting marine fishery resources and oceanographic research surveys; improve technical knowledge, skills and experiences of staff from SEAFDEC and the Member Countries through their participation in survey cruises; assist in the development of research cruise plans for vessels of SEAFDEC and the Member Countries; generate scientific knowledge to support the management of transboundary fishery resources in Southeast Asia; promote the application of Fisheries GIS and Remote Sensing for monitoring the marine fishery resources and environment; and sustain resource enhancement through establishment of artificial habitats. In 2020, the Project would particularly focus on the conduct of training, research and workshops on relevant subjects, e.g. marine debris, survey cruise, fishery resource and stock assessment, transboundary fishery resources, utilization techniques of fisheries GIS and RS, and impacts of establishment of artificial habitats on fishery resources and marine environment.	TD	JTF
8. Fisheries Management Strategies for Pelagic Fish Resources in the Southeast Asian Region (2020-2024) Starting with the participating countries, namely: Brunei Darussalam, Cambodia, Indonesia, Malaysia Myanmar, Philippines, Thailand and Viet Nam, the Project would support stock assessments and risk assessments for small pelagic fisheries as well as neritic tunas in the Southeast Asian region; clarify the stock structure for neritic tuna species in the region; and carry out life-history study for neritic tuna species in the region. For small pelagic species, MFRDMD would	MFRDMD	JTF

collect and compile regional information on targeted species for stock assessment and risk assessment and conduct the First Core Experts Meeting in 2020. For Neritic tuna species, regional information would also be collected and compiled for stock assessment and risk assessment. Pilot otolith studies would also be conducted for selected neritic tuna species.		
9. Management Scheme of Inland Fisheries in the Southeast Asian Region (2020-2024) In achieving the objectives toward the sustainable management and utilization of inland fishery resources in Southeast Asia, the Project would carry out two main activities, namely: 1) development and dissemination of the guidelines on inland fisheries management in Southeast Asia; and 2) establishment of catch database and profiles of freshwater fish biodiversity, and publication of the manual book on collection and sampling of inland fish biological characteristics. In 2020, meetings would be conducted among the AMSs to obtain data and information on the present status of inland fisheries management; while a writeshop would be organized to enhance the AMSs capacity in writing articles for publications and relevant institutional documents on inland fisheries. Surveys and data monitoring would also be conducted in selected sites in Indonesia and Myanmar.	IFRDMD	JTF
10. Small-scale Fisheries Management for Better Livelihood and Fisheries Resources (2020-2024) The Project aims toward the sustainable management of small-scale fisheries (SSF) for improving the livelihood and well-being of fishers in Southeast Asia. Specifically, the Project comprises three main activities: 1) Putting in place Ecosystem Approach to Fisheries Management (EAFM) in selected pilot sites in the Member Countries; 2) Capability development in the implementation of the SSF Guidelines for improving the livelihood and well-being of small-scale fishers; and 3) Promotion of gender integration and empowerment in sustainable fisheries management. In 2020, a regional workshop would be conducted for developing the EAFM implementation work plan in pilot sites, *e.g.* in Cambodia, Thailand, and Myanmar. Survey and data collection would be conducted on fisheries socio-economics in the Member Countries in order to develop the appropriate approaches/ processes of promoting fisheries micro-financing, credit and insurance for small-scale fishers. A regional workshop would also be conducted to share the information and knowledge on gender integration in SSF and promote the adoption of the SEAFDEC Gender Analysis Toolkit.	TD	JTF
11. Development of Stock Assessment Method for Strengthening of Resources Management Measures of Tropical Anguillid Eels in AMS (2020-2021) This project is considered a continuation of the first phase project “Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia”	SEC	JAIF

also funded by JAIF and implemented from 2017 to 2019 to develop eel fishery statistics and data collection system, examine the status of tropical anguillid eel species in AMS, and improve eel aquaculture activities. The new JAIF project would focus on: collecting catch data and biological/ ecological information for the estimation of eel resources stocks, and developing the mathematical/statistical methods for estimating tropical anguillid eel resources stocks that could be used for the formulation of effective management measures for the sustainable use of tropical anguillid eels in Southeast Asia. In 2020, a regional planning meeting will be organized to examine the validity of the developed methods for eel stock assessment, disseminate such methods to the AMSs, and prepare a manual on the effective resource management methods for tropical anguillid eels.		
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		
12. Sustainable Aquaculture through Cost-Effective Culture Systems, and Prompt and Effective Aquatic Animal Health Management (2020-2024) The Project, which aims to attain sustainable aquaculture through a cost-effective culture systems, as well as prompt and effective aquatic animal health management schemes, comprises various related activities. Specifically for 2020, the planned activities include: 1) Application of social preparation method to enable the implementation of community-based strategies for mass production of giant freshwater prawn juveniles in hatcheries and nurseries; 2) Cage trial using alternative feeds in tilapia juveniles using different feeding strategies; 3) Identification of organism that can be used in the constructed/artificial wetlands to improve water quality and purify pond effluents; 4) Survey and procurement of breeders of new aquatic species, *e.g.* kawakawa, shortfin scad, flathead lobster, and seahorse, for developing breeding and seed production techniques; 5) Comprehensive diagnosis on unknown mortalities and development of detection methods for the emerging diseases; 6) Studies on surveillance, distribution, occurrence and prevalence of *Enterocytozoon hepatopenaei* EHP; 7) Investigation of chemicals and methods for preventing transmission of WSSV and other important shrimp diseases; 8) Simulation tank trials for optimized disease control and management strategy against shrimp and other emerging diseases in brackishwater ponds; and 9) Training on sustainable aquaculture, particularly on rural aquaculture development.	AQD	JTF
Strategy III: Ensuring the food safety and quality of fish and fishery products for the Southeast Asian region		
13. Enhancing Food Safety and Competitiveness of Seafood Products (2020-2024) The Project is aimed at improving food safety and the competitiveness of seafood products in the ASEAN region	MFRD	JTF

through the conduct of training workshops and development of guidelines, with support of regional technical experts. The Project comprises two scopes: 1) developing regional standards and guidelines on Good Manufacturing and Handling Practices (GMP & GHP) for sushi and sashimi; and 2) introducing High-Pressure Processing (HPP) Processing Protocols for seafood. In 2020, which is the first year of this Project, two project inception and planning meetings will be organized to finalize the implementation plan of activities and identify the National Focal Points from each Member Country under the two scopes.		
Strategy IV: Enhancing trade and compliance of the region's fish and fishery products with market requirements		
14. Strengthening a Regional Cooperation and Enhancing National Capacities to Eliminate IUU Fishing in Southeast Asia (2020-2024) Starting from 2020, the Project would continue to promote the regional tools that had been developed by TD in combating IUU fishing under the Project "Promotion of Countermeasures to reduce IUU Fishing" which was completed in 2019. These regional tools include the Database on Regional Fishing Vessels Record (RFVR), enhanced regional cooperation to support the implementation of Port State Measures (PSM), and the electronic ASEAN Catch Documentation Scheme (eACDS) with a view to prevent the entry of fish and fishery products from IUU fishing into the supply chain. In 2020, the Project would conduct a Regional Technical Consultation to explore the ways forward for the development of the RFVR as well as other tools for combating IUU fishing. Capacity building on PSM in the AMSs would be sustained while expansion of the eACDS application to other countries would be continued in Viet Nam, Malaysia, and Myanmar.	TD	JTF
Strategy V: Addressing cross-cutting issues, such as labor, gender and climate change, where related to international fisheries		
15. Assistance for Capacity Development in the Region to Address International Fisheries-related Issues (2020-2024) The Project aims to ensure the sustainable utilization and sound management of fisheries resources through appropriate regional approaches in international fish trade. Specifically, SEAFDEC would continue to participate in relevant regional/international fora in order to be updated on international fish trade related issues. The project would also provide a platform where discussions among the ASEAN Member States (AMSs) can be convened for the development of regional approaches or common/coordinated positions and recommendations for national and regional action plans to safeguard the interest of the region; and also raise the awareness of the AMSs on international fisheries related issues. In 2020, SEAFDEC would continue to support and	SEC	JTF

strengthen the cooperation with the AMSs by supporting the secondment of four members of the Regional Fisheries Policy Networks (RFPNs) at the SEAFDEC Secretariat in Bangkok, Thailand.		
Strategy VI: Empowering SEAFDEC to strengthen its roles in the region and to improve its services to Member Countries		
16. Fisheries Resource Survey & Operational Plan for M.V. SEAFDEC 2 (since 2004) Technical support to SEAFDEC Member Countries for monitoring of their respective fishery resources and marine environmental conditions, and enhancing human resource development onboard the SEAFDEC research vessels, which has been sustained by TD since 2004. The M.V. SEAFDEC 2 was granted by the Government of Japan in 2004 to support the Member Countries' fishery resources and marine environmental surveys, and has since then been utilized to fulfill the needs of the requesting countries under the agreed cost-sharing scheme. In 2020, TD will continue to collaborate with the Member Countries and potential partners to support the countries on fishery resource and marine environmental surveys. SEAFDEC will also explore the possibility of improving the hydro-acoustic equipment which is useful for the surveys in the future.	TD	Cost sharing with AMSs requesting to use the vessel

2) Departmental Programs

Program Title	Department	Funding Source
1. Quality Seed for Sustainable Aquaculture – QSSA (2016-2020) The Program aims to generate, verify and promote technologies to ensure the sustainable production of quality seed stock for aquaculture as well as for stock enhancement. In 2020, the Project will continue to undertake studies on: • Verification of the effectiveness of SEAFDEC/AQD broodstock diets in improving the reproductive performance in tropical abalone, *Haliotis asinina* • Use of biofloc system to improve water quality, growth performance and disease resistance of *Penaeus monodon* and *Penaeus (Fenneropeneaus) indicus* juveniles reared in tanks (with a component under Healthy and Whole Aquaculture [HWA]) • Hatchery production and semi-intenstive pond culture of *Penaeus (Fenneropeneaus) indicus* (with a component under HWA) • Economic viability of tank-based polychaete culture technology • Use of algal paste in the larval rearing of mangrove crab *Scylla serrata* • Optimizing hatchery production of early juvenile sandfish *Holothuria scabra*	AQD	AQD*

• Development of techniques for sustainable mass production of harpacticoid copepods for marine fish and crustacean larviculture • Utilization of artificial illumination in floating net cages on the nursery culture of pompano *Trachinotus blochii* – Effects on the growth and survival of pompano and its added economic value • Optimization of electrolytic flocculator for paste production of important locally available microalgae in aquaculture • Development of a modified continuous culture system for the mass production of *Nanochlorum* spp. and *Brachionus rotundiformis* • Milkfish seed production • Seed production of donkey's ear abalone *Haliotis asinina* juveniles • Seed production of mangrove crab (*Scylla serrata*) with refinements on the feeding frequency • Sea-based nursery cages production of farmed Eucheumatoids • Development of optimal fish-prawn co-culture schemes in tanks and lake-based cages for increased farm production (with a component under Maintaining Environmental Integrity through Responsible Aquaculture [MEITRA]) • Verification studies on breeding and seed production of giant and hybrid groupers (*Epinephelus* spp.)		
2. Healthy and Wholesome Aquaculture (2016-2020) The Program has two main components, namely: 1) fish health; and 2) nutrition and feed. The Fish Health Component aims to improve aquaculture production through innovations in nutrition and feeding and fish health management in aquaculture and in maintaining the environmental integrity of aquaculture systems. Activities in 2020 will include: • Study on Tilapia Lake Virus (TiLV) with genomic sequencing and histopathological studies as well as tilapia sampling • Efficacy of different therapeutants against *Caligus* sp. infestation in tropical fish under laboratory conditions • Use of biofloc system to improve water quality, growth performance and disease resistance of *Penaeus monodon* and *Penaeus (Fenneropeneaus) indicus* juveniles reared in tanks (with a component under QSSA) • Hatchery production and semi-intenstive pond culture of *Penaeus (Fenneropeneaus) indicus* (with a component under QSSA) • Safeguarding the future of the seaweed industry of the Philippines: disease and pest detection • Detection, control, and treatment of persistent and emerging pathogens affecting pond-cultured Asian catfish (*Clarias macrocephalus*) • Field verification of the vaccination regimen in cage-cultured marine fish species (pompano, snapper, and grouper) broodfish in Igang Marine Station as a practical	AQD	AQD*

strategy to prevent the vertical transmission of nervous necrosis virus during seed production. The Nutrition and Feed Component aims to: 1) find effective alternative protein sources to fish meal in dietary formulations; 2) determine specific nutrients that enhance growth performances; and 3) promote practices and strategies to improve production. Activities in 2020 will include: • Production techniques for culture of silver therapon (*Leiopotherapon plumbeus*) in tanks and cages • Promoting alternative feeds for sustainable production of freshwater species • Evaluation of unfermented, fermented, and live green macroalgae *Chaetomorpha* sp. as food source for farmed *Penaeus monodon* and low-trophic level finfish • Grow-out culture of abalone comparing the use of *Gracilariopsis heteroclada* of SEAFDEC-formulated diet as feeds • Nutritional interventions to improve reproductive performance of Indian White Prawn (*Penaeus indicus*)		
3. Maintaining Environmental Integrity through Responsible Aquaculture (2016-2020) The general objective of the Program is to develop sustainable aquaculture technologies by integrating environmental factors in the AQD research activities and to maintain environmental integrity by promoting responsible aquaculture practices. In 2020, most of studies undertaken in the previous year will be continued. These are: • Increasing technical skills supporting community-based sea cucumber production in Viet Nam and the Philippines • Development of optimal fish-prawn co-culture schemes in tanks and lake-based cages for increased farm production (with a component under QSSA) • Demonstration and verification of sustainable and efficient aquaculture techniques by combination of multiple organisms • Strategic feeding of milkfish *Chanos chanos* for efficient marine cage culture production • Grow-out of abalone in pipes • Polychaete culture in raceway ponds	AQD	AQD*, DA-BFAR, ACIAR
4. Meeting Social and Economic Challenges in Aquaculture (2016-2020) 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 2020, the activities will include:	AQD	AQD*, JIRCAS

• Developing community-based sustainable aquaculture livelihood strategies in Laguna lake and tributaries • Assessment and development of community-based sea cucumber (*Holothuria scabra*) farming livelihood for fishing communities		
5. Adapting to Climate Change (2016-2020) The overall goal of the Program is to help ensure the sustainability of aquaculture amidst the expected impacts of disturbances in the culture environment brought about by climate change/global warming. In 2020, the Program will continue to incorporate climate change-resilient practices in studies conducted by AQD as well as in training and information materials.	AQD	AQD*
6. Collaborative Projects with the Philippine Government Two activities had been carried out by AQD to support the Philippines as the Host Government of AQD: 1) Joint Mission for Accelerated Nationwide Technology Transfer Program (JMANTTP II) to accelerate fish production and export revenues from the aquaculture sector; and 2) Establishment of a feed mill for a cost-efficient broodstock diet, aiming to identify and utilize cost-effective feed ingredients which can be used as an alternative to fish meal. For JMANTTP II, the activities in 2020 will include: • "*Oplan Balik Sugpo*" program to produce disease-free fry by following strict biosecurity protocols and the possible acquisition of SPF spawners • *In situ* training courses and extension work and technology transfer of aquaculture technologies developed by AQD • Training course on manpower development for shrimp, marine fish, and tilapia Aquaculture • Profiling of operating, abandoned or non-operating hatcheries in the province of Iloilo, Philippines • Feasibility study of legislated multi-species hatchery For Cost-efficient Feed, the activities in 2020 will include: • Second run of test feeding of AQD formulated feed versus commercial feeds in selected sites, with analysis of growth, survival, water parameters, proximate, and cost-and-return • (Upon successful experimentation) mass production of feed formulation with the assistance of project partners, and transfer of feed formulation to fish farmers	AQD	BFAR, NFRDI
7. Promotion on Strengthening of SEAFDEC Visibility and Enhancing Human Capacity Building The Program has the overall objective of strengthening visibility and image of SEAFDEC through TD, while also enhancing the knowledge and experience of relevant agencies and stakeholders on fisheries-related issues. In 2020, the activities have been categorized into: 1) Promotion and enhancement of SEAFDEC visibility and image, *e.g.* through national and international exhibitions; 2) Production of information materials	TD	TD*

through the publication "Advance Fisheries Technology," among others; 3) Management information system for sharing of web-based information; and 4) Enhancing human capacity building including conduct of tailor-made training based on needs of partners and donors.		
8. Improving of Fisheries Technology and Reduction of the Impact from Fishing Activities The Program has the overall objective of improving fishing technologies and marine engineering to support the sustainable utilization of marine fishery resources. In 2020, the activities would be under three categories, namely: 1) Promotion of appropriate technologies and practices of fishing and marine engineering, including reduction of manpower in fishing operations, safety at sea, marking of fishing gear, improving fishing gear design and survey equipment, among others ; 2) Study on the impacts of fishing activities on fishery resources, marine environment, and social well-being and livelihoods of fishers; and 3) Development of database from the fishery resources surveys, socio-economic and small-scale fisheries studies to support fisheries management.	TD	TD*
9. Stock Assessment in Inland Fisheries The Project has the overall objective of establishing fish stocks and fish production potential in Fisheries Management Areas in selected inland waters of Indonesia, and establishing the data on the value of fish stocks, Maximum Sustainable Yield (MSY), fish production potential, and total catch in the respective areas.	IFRDMD	Indonesia
10. Improve Livelihoods from Responsible Fisheries and Capacity for Conservation, by Preserving Clown Knife Fish Habitats and Protecting Their Occurrence The Project aims to establish a detailed Master Plan for the clown knife fish culture demonstration, implement good practices on clown knife fish culture and responsible aquaculture, including feed and monitoring, and other support during culture period, and ensure evaluation and dissemination of results to stakeholders. In 2020, the Project would implement activities on restocking and distribution of clown knife fish seeds to local farmers; preparation and dissemination of guidelines for hatchery and spawning of clown knife fish; and conduct of workshop to disseminate good aquaculture practices based on EAFM/EAA to local stakeholders.	IFRDMD	FAO
11. Modernizing Irrigated Agriculture to Protect and Restore Aquatic Biodiversity and Ecosystem Services in Southeast Asia The Project aims to: develop technical guidelines for the design and operation of irrigation infrastructures to sustain freshwater fisheries productivity and conserve aquatic biodiversity; build institutional and policy-level awareness in Myanmar	IFRDMD	FAO

and Indonesia of the processes and benefits of integrating the design of irrigation infrastructures with enhancement of natural resource productivity and biodiversity; and disseminate the processes and build capacity at national and regional levels to manage irrigation infrastructures for improved productivity of irrigated agriculture and living aquatic resources. In 2020, the Project will develop and disseminate materials for technical and policy guidance, provide stakeholders consultation and buy-in; and conduct capacity building at national and regional levels.		

*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, extended to 2020) The Project aims to build capacity within with 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 Project planned to complete in 2019 the construction of demonstration fish passages, one each in Cambodia, Thailand, and Viet Nam. However, considering that some of the Project activities have not yet been completed, the Project was extended for another year in 2020.	TD	US-DOI

In addition to the above projects and programs, there were also two (5) **pipeline projects** of which the proposals are being 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. ASEAN-JICA Food Value Chain Development Project	SEC	JICA
2. ASEAN-JICA Cooperation for Capacity Building on IUU Fishing Countermeasures in Southeast Asia	TD	JICA
3. Gender Dimension in the Value Chain of Small-Scale Fisheries & Aquaculture in Southeast Asia	TD	FAO
4. Sustainable Management of Fisheries, Marine Living Resources and Their Habitats in the Bay of Bengal Region for the Benefit of Coastal States and Communities: Support to SEAFDEC Member Countries	TD	FAO
5. Piloting the Electronic ASEAN Catch Documentation Scheme (eACDS) in Viet Nam	TD	World Bank

COOPERATION WITH DONORS AND OTHER ORGANIZATIONS IN 2019

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

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

The 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 2019, twenty-three (23) projects were implemented by SEAFDEC under the FCG/ASSP Mechanism. The progress and achievements in the implementation of these projects were reported to the 22nd Meeting of the FCG/ASSP organized on 14-15 November 2019 in Chiang Mai, Thailand.

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 (RES&POA-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. Specifically, in 2019, two new regional guidelines developed by SEAFDEC were endorsed by the ASEAN at the 41st Meeting of the ASEAN Ministers on Agriculture and Forestry (AMAF), *i.e.* the "Regional Guidelines on Cold Chain Management for Seafood" and the "Regional Technical Guidelines on Early Warning System for Aquatic Animal Health Emergencies." SEAFDEC also organized a series of events in 2019 to review and revise the RES&POA-2020 to ensure that the provisions are up-to-date and continue to accommodate the emerging issues and anticipated priorities of the Southeast Asian region in the coming decade. Series of events were organized to develop the draft "Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2030" which would be submitted for consideration by the SEAFDEC Council and the ASEAN authorities in 2020.

In addition, SEAFDEC was also represented in several regional events organized by the ASEAN in 2019. These events include the following:

- ASEAN Working Group on CITES and Wildlife Network Meeting (2-4 April 2019, Sandakan, Malaysia)
- ASEAN Meeting on Combating IUU Fishing (4-5 April 2019, Bangkok, Thailand)
- Inception Meeting on the Development of an ASEAN General Fisheries Policy Feasibility Study (22-23 May 2019, Bangkok, Thailand)
- 11th Meeting of the ASEAN Fisheries Consultative Forum (AFCF) (25-26 June 2019, Da Nang, Viet Nam)
- 27th Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGFi) (27-29 June 2019, Da Nang, Viet Nam)

- 2nd ASEAN Meeting on Combating IUU Fishing (13-14 December 2019, Bangkok, Thailand)

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

SEAFDEC signed with the CITES Secretariat the Small-Scale Funding Agreement (SSFA) in 2018 to co-operate in support of 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 (NDFs). The activities undertaken under this SSFA include: 1) Assistance to 4 information-poor Parties (Myanmar, Viet Nam, Cambodia, Philippines) on catch data collection for sharks and rays at the species level, to improve their capacity to make NDFs for CITES-listed species in the medium-term; 2) Support to 3 Parties (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. The Project started in 2018, and was scheduled to be completed in September 2019. However, as there are some activities that have yet been completed, the amendment was approved for the SSFA to be extended until 15 December 2019.

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

SEAFDEC/AQD signed a Letter of Understanding (LOA) with FAO in September 2018 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 which covered the period until 31 July 2019, AQD would produce full-text PDF files of documents published by SEAFDEC for deposition in open-access repository, prepare ASFA records for inclusion in the ASFA database, and provide links for digitized documents with existing ASFA records. However, as some of the activities under this LOA have not yet been completed, in March 2019, AQD signed an Amendment to the LOA to extend the expiration date to 30 November 2019.

In February 2019, a Letter of Agreement was also signed between FAO and SEAFDEC/IFRDMD for the implementation of the "Development of Capacity Building Plan to support Management of Inland Aquatic Resources, Development of EAFM/EAA Training Modules and Conducting Training of Trainers on EAFM/EAA." Under this LOA, IFRDMD would support the implementation of the project on "Mainstreaming Biodiversity Conservation and Sustainable Use into Inland Fisheries Practices in Freshwater Ecosystems of High Conservation Value" (IFISH) funded by GEF with FAO as the Executing Agency and the MMAF of Indonesia as Government Executing Partner. IFRDMD would also prepare development and/or improvement of capacity building plan to support the management of inland aquatic resources, development of EAFM/EAA training modules, and conduct Training of Trainers on EAFM/EAA at 5 locations (Cilacap District, Sukabumi District, Kampar District, Kapuas District and South Barito District) under the IFISH project. The duration of this LOA was until November 2019.

In March 2019, SEAFDEC and FAO signed another Letter of Agreement for the "Joint Effort to Organize the Capacity Development Workshop on Estimation and Reporting of SDG Indicator 14.4.1 for the Asia Pacific Region." Under this LOA, SEAFDEC organized the "Capacity Development Workshop on Estimation and Reporting of SDG Indicator 14.4.1 for the Asia Pacific Region" on 2-4 October 2019 participated by representatives from the SEAFDEC Member Countries as well as other countries in the Asia and Pacific Region.

Throughout 2019, SEAFDEC had been involved in regional and international events organized by FAO with a view to ensuring that activities and initiatives promoted by SEAFDEC are harmonized with relevant international instruments and initiatives. These include, among others:

- FAO Expert Advisory Panel for the Assessment of Proposal to Amend CITES Appendices (21-25 January 2019, Rome, Italy);
- Project Inception Workshop of the Project Preparatory Grant (PPG) Works of BOBLME Project (12-13 March 2019, Bangkok, Thailand)
- BOBLME-II PPG Project Steering Committee Meeting (14 March 2019, Bangkok, Thailand)
- Expert Workshop on Guidelines for Micro-finance, Credit and Insurance for Small-scale Fisheries in Asia (7-9 May 2019, Bangkok, Thailand)
- 11th Fisheries and Resources Monitoring System (FIRMS) Steering Committee Meeting (13-14 May 2019, Rome, Italy)
- 5th Global Record Working Group Meeting 13-14 May 2019, Seoul, Korea)
- 2nd PSMA Technical Working Group on Information Exchange (15-17 May 2019, Seoul, Korea)
- 26th Session of the Coordinating Working Group (CWP) on Fishery Statistics (15-18 May 2019, Rome, Italy)
- 2nd Meeting of the Parties to the PSMA and 3rd Meeting of the Part 6 Working Group (3-6 June 2019 and 7 June 2019, Santiago, Chile)
- FAO Workshop on Best Practices to Prevent and Reduce Abandoned, Lost or Otherwise Discarded Fishing Gear (8-11 July 2019, Bali, Indonesia)
- Regional GEF PIF Validation Workshop on "GoTFish": Promoting the Blue Economy of the Gulf of Thailand through Ecosystem Approach to Fisheries" (1-2 August 2019, Bangkok, Thailand)
- Capacity Development Workshop on Estimation and Reporting of SDG Indicator 14.4.1 for the Asia and Pacific Region (2-4 October 2019, Bangkok, Thailand)
- Asia-Pacific Day for Ocean (8 November 2019, Bangkok, Thailand)
- 17th Session of the FAO/COFI Sub-Committee on Fish Trade (25-29 November 2019, Vigo, Spain)

During the year, FAO also extended technical support to SEAFDEC through the participation of its experts in several events organized by SEAFDEC, including, among others:

- Regional Consultation for Development of the ASEAN-SEAFDEC Common Position on the Proposed Listing of Commercially-exploited Aquatic Species into the CITES Appendices (organized by SEAFDEC Secretariat on 30-31 January 2019, Bangkok, Thailand)
- Meeting on RFVR in Southeast Asia (organized by TD on 13 to 14 May 2019, Seoul, the Republic of Korea) as side event during the Fifth Meeting of the Global Record Informal Open-Ended Technical and Advisory Workshop Group (GRWG5)

- Experts Consultation Workshop on Finalization of the Practical Guide for Gender Analysis in Small-Scale Fisheries and Aquaculture in Southeast Asia (10-11 July 2019, Samut Prakan, Thailand)
- Regional Training on Port State Measures (PSM) Implementation for Inspectors in Southeast Asia (organized by TD on 22 to 26 July 2019 at SEAFDEC/TD, Samut Prakan, Thailand)
- Regional Core Experts Meeting on Tropical Anguillid Eel Information Sharing (3-4 October 2019, Samut Prakan, Thailand)

- **Government of Sweden**

In sustaining its cooperation with SEAFDEC, the Government of Sweden provided funding support for the 5-year project "Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia" implemented by SEAFDEC from 2013 to 2017 and later on extended until 2019. The Project had three output objectives, namely: 1) Capacity built for integration of fisheries and habitat management and adaptation to climate change; 2) Capacity built and system improved for the management of fishing capacity (monitoring, record and control); and 3) Capacity built and policy development process improved for the drafting and implementation of regional and sub-regional agreements, 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. The Project completed the cooperation in 2019 with the conduct of the "End-of-Project Meeting of the SEAFDEC-Sweden Project: Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia Project (2013-2019)" on 30-31 October 2019 in Bangkok, Thailand.

- **Intergovernmental Organization for Marketing Information and Technical Advisory Services for Fishery Products in the Asia and Pacific Region (INFOFISH)**

In responding to the request by the Member Countries during the past few years for SEAFDEC to exert efforts in updating the synthesis on development of international fish trade, including providing links in SEAFDEC website to the information compiled, *e.g.* price, international fish trade profile of the Member Countries, and while considering that this particular concern is also under the mandate of INFOFISH, collaboration between SEAFDEC and INFOFISH has therefore been initiated. Through such arrangement, SEAFDEC officials had been able to attend the 32nd INFOFISH Technical and Advisory Board (TAB) Meeting (1-4 July 2019, Kuala Lumpur, Malaysia), and the 34th INFOFISH Governing Council Meeting (16-19 December 2019, Maldives). Furthermore, with a view to enhancing the benefit from SEAFDEC activities for the sustainability of fisheries, SEAFDEC also invited participants from INFOFISH Member Countries (that are not SEAFDEC Members) to attend in the "Regional Training Course on Port State Measures Implementation for Inspector" organized by SEAFDEC/TD on 22-26 July 2019 in Samut Prakan, Thailand.

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

In 2019, the Japan-ASEAN Integration Fund (JAIF) provided financial support to SEAFDEC for the implementation of the Project "Strengthening the Effective Management Scheme with GIS (Geographic Information System) and RS (Remote Sensing) Technology for Inland

Fisheries and Aquaculture at AMSs," which aims to use of GIS Mapping/RS Technology to understand the relationship between environmental data and the catch amount for the effective management of inland fisheries and aquaculture, and which would run until June 2020. Meanwhile, the proposed Project "Development of Stock Assessment Method and Strengthening of Resources Management Measures on Tropical Anguillid Eels in ASEAN Region," which is undergoing discussions between SEAFDEC and JAIF, is expected to commence in early 2020.

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

The Government of Japan 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; and in 2018, SEAFDEC with the support of JICA pursued the "Follow-up Cooperation for the Project for Construction of a Fisheries Research and Training Vessel" by installing the necessary equipment, *i.e.* modern navigation and communication equipment, parts of engines and fishing accessories. On 19 March 2019, TD conducted a cruise as a follow-up to this cooperation so that the concerned Navigators of the M.V. SEAFDEC 2 would understand and be able to operate the new equipment and instruments. In addition, Engineers of the M.V. SEAFDEC 2 were also trained in Japan in 2019 for them to obtain knowledge and experience on engine maintenance for the main engine, auxiliary engine, and deck machineries, among others.

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

Since 2016, SEAFDEC has served as implementating 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 2019 Letters of Agreement were signed between Viet Nam and Indonesia, making all participating countries involved in the Project implementation. Besides the national activities conducted by the respective participating countries, SEAFDEC organized the "Second Meeting of Regional Scientific and Technical Committee (RSTC2)" on 21-23 May 2019 in Kampot Province, Cambodia to establish the regional cooperation in the integration of scientific knowledge and research outputs with management. Subsequently, the "Second Meeting of Regional Project Steering Committee (PSC2)" was also organized on 5-6 November 2019 in Malaysia, where updated national and regional programs were presented for consideration and endorsement by the Committee.

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

SEAFDEC has collaborated with the United States Agency for International Development (USAID) since 2015 for the implementation of the Project "Oceans and Fisheries

Partnership" or the USAID Oceans, which aimed 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. The USAID Oceans was carried out until its final closure in early 2020.

In addition, USAID together with other partners also collaborated with SEAFDEC to strengthen the capacity of the countries in the region in the implementation of PSM and other surveillance measures, particularly in the "Regional Training on Port State Measures (PSM) Implementation for Inspectors in Southeast Asia" organized from 22 to 26 July 2019 at TD in Samut Prakan, Thailand.

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

SEAFDEC signed a Memorandum of Understanding (MOU) with the United States Department of Interior (US-DOI) in 2018, which included an Annex for SEAFDEC to support the "Implementing the Lower Mekong Fish Passage Initiative in Cambodia, Thailand, and Viet Nam." 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 Viet Nam; 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 which originally started from the date of signing until 30 September 2019 was extended until September 2020.

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

The 2019, the National Oceanic and Atmospheric Administration (NOAA) continued to extend support to several activities undertaken by SEAFDEC/TD, particularly in the capacity building of AMSs on Port State Measures (PSM) and updating the training modules for the Ecosystem Approach to Fisheries Management (EAFM).

On the PSM, NOAA together with other partners also collaborated with SEAFDEC to strengthen the capacity of the countries in the region in the implementation of PSM and other surveillance measures, particularly in the conduct of the "Regional Training on Port State Measures (PSM) Implementation for Inspectors in Southeast Asia" organized from 22 to 26 July 2019 at TD in Samut Prakan, Thailand, where experts of NOAA served as resource persons. With regards to the EAFM, TD also collaborated with NOAA in updating/revising the E-EAFM training materials and organized the "2nd EAFM Workshop for Developing EAFM Toolkits" on 3-7 June 2019 at its premises in Samut Prakan. Subsequently, TD collaborated with NOAA in the conduct of the "Regional Workshop on Lessons Learned from Application of Ecosystem Approach to Fisheries Management (EAFM) in Different Learning Sites"

during 7-8 October 2019 in Bangkok, Thailand, and came up with a compilation of lessons learnt from the EAFM implementation/application in various learning sites and the way forward for future implementation of the EAFM in the Southeast Asian region. Back-to-back with the Regional Workshop, the "SEAFDEC Capacity Building for Trainers Developing Communications" was also organized with the support of NOAA on 9-11 October 2019, also in Bangkok, Thailand.

Cooperation with National Agencies of SEAFDEC Member Countries

- **Agency for Marine and Fisheries Research and Human Resources Ministry of Marine Affairs and Fisheries (AMAFRHR), Republic of Indonesia**

In January 2019, SEAFDEC signed the "Arrangement for Cooperation between Agency for Marine and Fisheries Research and Human Resources Ministry of Marine Affairs and Fisheries (AMAFRHR), Republic of Indonesia and SEAFDEC Concerning Research Cooperation on Inland Fisheries in the Member Countries of SEAFDEC" with a view to facilitating the allocation of resources for regional activities of the SEAFDEC Inland Fishery Resources Development and Management Department (IFRDMD), as well as allowing entry of foreign researchers under SEAFDEC projects into Indonesia. The Arrangement will be effective until December 2022. This Arrangement was annexed with four Plans of Operation which shall be constituted as an integral part of this Arrangement, namely: 1) Research activities on catadromous eel resources in Southeast Asia; 2) Research activities on promotion of responsible utilization of inland fisheries in Southeast Asia; 3) Research activities on enhancing sustainable utilization and management scheme of tropical anguillid eel resources in Southeast Asia; and 4) Research activities on strengthening the effective management of inland fisheries and aquaculture in AMS with GIS and RS technology.

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

SEAFDEC had cooperated with the Arrangement for Scientific and Technical Cooperation with the Japan Fisheries Research Agency (formerly FRA) since 2004, and the Arrangement for Academic and Educational Cooperation with National Fisheries University (NFU) since 2005. As the former FRA and the NFU were recently merged into the new Japan Fisheries Research and Education Agency (new FRA), the new Arrangement was therefore signed between SEAFDEC and the new FRA. The "Arrangement for Scientific and Educational Cooperation between Japan Fisheries Research and Education Agency (FRA) and SEAFDEC" was signed on 22 January 2019 with the objectives of: 1) developing scientific and technical cooperation in various fields that are of interest to the two relevant organizations under the mutual understanding and interrelationship; and 2) developing academic and educational cooperation in various fields that are of interest to the two relevant organizations under the mutual understanding and interrelationship. This new Arrangement will be valid for the period of five (5) years.

In 2019, the FRA also continued to provide technical support to SEAFDEC. Specifically, a number of experts were dispatched to the SEAFDEC Departments, namely: *Dr. Koichiro Mori* as Deputy Chief of AQD, *Dr. Masaya Katoh* as Deputy Chief of MFRDMD; and

Dr. Takuro Shibuno as Deputy Chief of IFRDMD. The FRA also dispatched experts to provide assistance to the SEAFDEC technical activities, *i.e. Dr. Tsutomu Nishida* on stock assessment of highly migratory species; *Dr. Hidetada Kiyofuji* on skipjack growth analysis; *Dr. Satoshi Miwa* as resource person during the Regional Technical Consultation on Aquatic Emergency Preparedness and Response Systems; and *Dr. Tsutom Miyata* (FRA) to support the activities under the Project "Information gathering through introduction of community-based resources management/co-management," among others.

- **Hokkaido University, Japan**

The "Arrangement for Scientific, Education, and Technical Cooperation between SEAFDEC and the Faculty of Fisheries Sciences, Hokkaido University of Japan (FFS-HU)" was signed in 2006 for cooperation toward the sustainable development of fisheries, and the Arrangement was extended in 2011 and 2016, respectively. Under this cooperative framework, in 2019, Hokkaido University continued to extend support to SEAFDEC and the Member Countries with particular focus on fish stock assessment. Specifically, *Prof. Dr. Matsuishi Takashi Fritz* from Hokkaido University supported MFRDMD in the preparation of the final report on purse seine fisheries in the Southeast Asian region. Furthermore, under the support from Sakura Science Plan by Japan Science and Technology Agency, ten staff from TD, AQD, MFRDMD, and IFRDMD were granted study tour to Hokkaido University to enhance their knowledge on fisheries management through formal lectures and visit to fishing ports in Hakodate.

- **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, SEAFDEC/TD in 2019 collaborated with TUMSAT and other agencies, *i.e.* Chulalongkorn University and Department of Marine and Coastal Resources (DMCR), Thailand, to investigate the sources of marine debris in Southeast Asia particularly in the Gulf of Thailand. Toward this end, a "Shipboard Training on Marine Debris Observation and Marine Debris Research Survey in Gulf of Thailand by M.V. SEAFDEC 2" was conducted from 29 November to 21 December 2019 in the survey area focusing on the Thai Exclusive Economic Zone in the Gulf of Thailand.

- **Nagano University, Japan**

On 19 July 2019, SEAFDEC signed the "Memorandum of Understanding (MOU) for Scientific and Educational Cooperation Between Nagano University and SEAFDEC." The objectives of the MOU are to: 1) Develop scientific and technical cooperation on inland fisheries and freshwater ecology that are of interest to the two organizations through mutual understanding and interrelationship; 2) Develop academic and educational cooperation on inland fisheries and freshwater ecology that are of interest to the two organizations through mutual understanding and interrelationship; and 3) Conduct detailed discussions between Nagano University and SEAFDEC if required, in cases when relevant practical matters may arise. The MOU is effective for the period of five years.

- **Faculty of Fisheries, Kagoshima University, Japan**

On 26 August 2019, SEAFDEC signed an "Extension of Arrangement for Academic and Educational Cooperation between SEAFDEC and Faculty of Fisheries, Kagoshima University" with a view to promoting the cooperation and collaboration toward the sustainable development of fisheries in the Southeast Asian region. The Arrangement of Cooperation between SEAFDEC and the Faculty of Fisheries, Kagoshima University, Japan was first established in 2003, and extended in 2008 and 2014, respectively, and was completed in May 2019. Under this new Extension of Arrangement, the two institutions encourage direct contact and cooperation between their staff members, departments/research sections in the following forms of cooperation: 1) Collaboration of faculty and staff members for research, symposia and other academic pursuits; 2) Exchange of staff members and students for education, training and research; and 3) Exchange of data, documentation and research materials in the field of mutual interests. The Extension of Arrangement is effective from the date of signing for the duration of five years.

- **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. In 2019, under the framework of this MOU, Gifu Prefecture supported the participation of officials, one each from the Southeast Asian countries, namely: Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, and Thailand, to the training program from 1-10 October 2019 at Gifu Prefectural Research Institute for Fisheries and Aquatic Environments and Inland Fisheries Training Center in Gifu, Japan.

- **National Fisheries Research and Development Institute (NFRDI) and Bureau of Fisheries and Aquatic Resources (BFAR), Philippines**

SEAFDEC/AQD signed on 14 June 2019 a Memorandum of Agreement with the National Fisheries Research and Development Institute (NFRDI) and Bureau of Fisheries and Aquatic Resources (BFAR) of the Philippines to collaborate in the implementation of "Aquafeed Research, Development and Extension Project (ARDEP)" with a view to developing low-cost quality aquaculture feeds for the priority species in the Philippines. The Parties agreed to: 1) Jointly undertake the research, development and extension in the ARDEP activities; 2) Cooperate in research, development and extension including training, technical assistance and use of facilities; and 3) Exchange and sharing of research materials, publications and other scientific information. Under the MOA, NFRDI will act as Lead Agency and member of the Technical Working Group (TWG) in the implementation of the project, and will provide funds to AQD for the conduct of the project; while AQD as Cooperating Agency and member of the TWG in the implementation of the project will submit a Project Proposal on aquafeed research, development and extension for approval of NFRDI, and conduct and implement the study in accordance with the approved Project Proposal. Meanwhile, BFAR as cooperating agency, will be providing facilities and manpower compliment in the

selected field testing sites in its National Technology Centers and Regional Offices. The duration of this project is from July 2018 until June 2021.

- **Marine Aquaculture Centre (MAC), Singapore**

The Post-harvest Technology Center (PHTC) of the Agri-Food & Veterinary Authority (AVA), Singapore served as Collaborating Centre of SEAFDEC to undertake the activities of MFRD under the SEAFDEC Regional Programmes from 2007 to 2019. In April 2019, a new statutory board, the Singapore Food Agency (SFA) was formed from the merger of AVA and part of 2 other statutory boards. The Marine Aquaculture Centre (MAC) of SFA replaced PHTC as the SEAFDEC Collaborating Centre to implement MFRD programmes in enhancing the development of fisheries post-harvest technology in the Southeast Asian region. In 2019, the implementation of one regional project “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” supported by the Japanese Trust Fund to SEAFDEC, was continued by MAC.

ENHANCING SEAFDEC VISIBILITY IN 2019

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 2019, the progress and achievements made by SEAFDEC in the implementation of information activities were monitored and discussed during the 20th Meeting of the Information Staff Program (ISP) from 15 to 17 October 2019 in Puerto Princesa, Philippines. The progress of the activities corresponding to the five Information Strategies is shown below:

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

- Technical/scientific materials: 49 title/issues: 14,919 copies produced, 5,630 copies distributed, and 4,781 e-copy distributed
- Technical videos: 32 titles, 32 hardcopies produced, and 532 online views (no hardcopy distributed)
- Technical/scientific articles: 64 titles: 26 titles published in SEAFDEC publications, and 38 titles published in non-SEAFDEC publications
- Inquiries for information through the SEAFDEC libraries recorded and replied: 3,474 queries recorded, 1,822 materials sold, and 18,874 citations

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

- Promotional materials: 25 titles/issues: 28,494 copies produced, 20,357 copies distributed, and 9,112 e-copies distributed
- Promotional souvenirs: 14,635 items produced, and 9,950 items distributed
- Promotion videos: 4 titles: 3 hardcopies produced, and 338 online views (no hardcopy distributed)
- SEAFDEC websites established: SEAFDEC Secretariat and Departmental websites received a total of 105,701 unique visitors, 9,846 links from other websites
- Project websites: 1,313 unique visitors, and 12 links from other websites
- Social media administered by SEAFDEC: 22,950 unique visitors, and 110,388 likes
- Participation in exhibitions and related events: joined 11 exhibitions with 48,786 visitors recorded at SEAFDEC exhibition booths and displays
- Official press statements released: thirty-two (32) press statements released, and recorded 152 appearances of SEAFDEC in public media and websites

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

- Management of libraries of SEAFDEC Secretariat and Departments: SEAFDEC Secretariat and Departments libraries continued to provide library services
- Additional acquisitions of SEAFDEC libraries: total of 306 issues of newsletters/serial publications, 292 titles of technical publications and 175 items of audio-visual materials were acquired
- Cooperation and exchange of materials: sustained cooperation with 485 network libraries within and outside the region
- Dissemination of technical and promotional materials: 55 titles (with 5,730 copies) of technical materials, and 34 titles (with 22,389 copies) of promotional materials disseminated to target groups
- Accessibility of information materials: 7,200 downloadable materials, 4,126,200 downloads during reporting year, and 8 databases made accessible in SEAFDEC websites
- The Institutional Repository: 1,368,326 accesses, 1,341,931 unique visitors; 1,188 titles uploaded during reporting year, 9,314 accumulated titles, and 1,783,347 accumulated downloads
- Usage of e-mail systems (including e-groups) to facilitate communications both among SEAFDEC staffs and with other concerned personalities had been enhanced
- Direct visitors to SEAFDEC Secretariat and Departments: recorded a total number of 12,713 visitors
- Participation of SEAFDEC officials to events organized by other organizations: 330 SEAFDEC officials participated in 206 events: 92 officials in events at regional/ international levels, and 114 at national/local levels
- Number of presentations made by SEAFDEC Staff at non-SEAFDEC events: 25 oral presentations in events at regional/international levels; and 12 oral presentations, and 1 poster presentation in events at national/local levels
- SEAFDEC events organized:
  - International/regional meetings, seminars, workshops: 32 meetings with 1,169 participants
  - National/local meeting, seminars, workshops, consultations: 19 meetings with 414 participants
  - International/regional training courses: 23 courses with 220 trainees
  - National, on-site training courses: 38 courses with 775 trainees
  - Study tours: 5 programs with 73 trainees
  - Internships: 1 group with 5 interns
  - On-the-job training: 5 colleges participated with a total of 244 students
  - Internal meetings: 17 meetings with 2,305 participants
- Participation of officials from Member Countries in events organized by SEAFDEC:
  - International/regional meetings, seminars, workshops (583 participants)
  - National/local meetings, seminars, workshops, consultations (379 participants)
  - International/regional training courses (159 trainees)
  - National on-site training courses (775 trainees)
  - Study tours (35 trainees)
  - Internships (11 persons)
  - On-the-Job training (241 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 2019: US$ 6,004,984 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 15-17 October 2019 in Philippines)

Table 1. Participation of Member Countries in SEAFDEC Events in 2019

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	18	57	104	39	41	51	37	47	14	130	45
SEAFDEC national/local meetings, seminars, workshops, consultations	0	4	0	3	130	47	3	22	0	150	20
International/ regional training courses	2	15	9	5	2	17	11	64	4	19	11
National, on-site training courses (course/trainees)	42	20	219	0	24	8	0	223	0	188	51
Study tours (no. of program/trainees)	0	5	0	0	30	0	0	0	0	0	0
Internships (group/persons)	0	0	0	0	0	0	0	6	0	5	0
On-the-job training (college/students)	0	0	0	0	0	0	0	236	0	5	0
SEAFDEC internal events	0	0	50	32	0	2	10	294	0	1457	1
TOTAL	**62**	**101**	**382**	**79**	**227**	**125**	**61**	**892**	**18**	**1954**	**128**

IMPLEMENTATION OF SEAFDEC GENDER STRATEGY IN 2019

The SEAFDEC Gender Strategy was approved during the Fifty-first Meeting of the SEAFDEC Council in 2019 for implementation by the SEAFDEC Secretariat and Departments, with the goal towards having "SEAFDEC as gender-responsive and gender-sensitive in pursuing sustainable development and management of fisheries and aquaculture in Southeast Asia." The Progress in the implementation of the Gender Strategy by SEAFDEC during the year 2019 is summarized as follows:

Strategy 1: Mainstreaming gender at all levels of the organization

- Policies and regulations for the staff: generally applied equally to male and female, with some specific gender-related policies, *e.g.* maternity/paternity leave, special leave benefits for women
- Gender-related facilities: provided as and when necessary, *e.g.* breastfeeding areas, child care facilities, Muslim prayer room for men/women
- Number of staff in HR system: a total of 381 staff (169 females and 212 males)
- Attendance of staff in gender-related training: 4 staff (3 females; 1 males)

Strategy 2: Integrating gender in SEAFDEC programs and projects

- Gender sensitive programs/projects: 5 regional projects (out of 23) are gender sensitive
- Stakeholders and participants involved in programs/projects of SEAFDEC: 4,730 stakeholders/participants (1,410 females and 3,320 males)
- Gender-related events organized by SEAFDEC: 4 events, with a total of 166 participants (119 females and 47 males) in attendance
- Project proposal developed to seek funding support from other organizations: 1 proposal developed with the budget requested in the amount of 98,000 US$

Strategy 3: Incorporating gender perspectives in all events organized by SEAFDEC

- Sex disaggregated number of participants in events organized by SEAFDEC:
  - Regional/international meetings, seminars, workshops: 32 events, with 1,169 participants (371 females and 696 males)
  - SEAFDEC national/local meetings, seminars, workshops, consultations, etc.: 19 events, with 414 participants (87 females and 252 males)
  - International/regional training courses: 23 events, with 220 participants (42 females and 155 males)
  - National, on-site training courses: 38 events, with 775 participants (141 females and 331 males)
  - Study tours: 5 events, with 73 participants (4 females and 13 males)
  - Internships (group/persons): 1 event, with 5 participants (2 females and 3 males)
  - On-the-job trainings (students): 5 events, with 224 participants (138 females and 106 males)
  - SEAFDEC Internal Events: 17 events, with 2,305 participants (280 females and 368 males)

Strategy 4: Boosting the visibility of SEAFDEC as a gender-responsive and gender-sensitive organization

- Presentation on gender-related subjects at events organized by other organizations: 5 oral presentations
- Gender-related articles/papers/reports published and distributed: 8 titles, with 2,070 hard-copies produced, 1,350 hard-copies distributed, and 440 e-copy downloaded

Strategy 5: Strengthening further the cooperation and collaboration with Member Countries and other organizations on gender aspects

- Collaboration with 3 organizations/countries by serving as resource persons on gender at the events

SEAFDEC REVENUES AND EXPENDITURES IN 2019

Southeast Asian Fisheries Development Center
Un-Audited Abridged Consolidated Financial Statements-2019 (in US$)

	2019 (Un-audited)		2018 (Audited)	
REVENUES				
Contributions from:				
Member governments	10,879,078		10,210,335	
Other sources	2,262,270		1,794,569	
Other income	603,759		733,319	
Total Revenues	13,745,107		12,738,223	
EXPENDITURES				
Operating and Capital Expenditures				
Research	3,636,093		3,385,902	
Training	1,661,169		1,099,909	
Information	664,194		651,055	
Collaborative	199,091		128,327	
Others	724,824		643,731	
Administrative	4,769,243		5,161,600	
Total Expenditures	11,654,614		11,070,524	
SURPLUS (DEFICIT), For the year	2,090,493		1,667,699	
FUND BALANCE, Beginning of year	13,032,274	1/	10,579,181	
FUND ADJUSTMENT	(7,246)		(9,726)	
FUND BALANCE, End of year	15,115,521		12,237,154	1/
REPRESENTED BY:				
Cash and cash equivalents	15,942,569		13,199,838	
Other receivables	360,089		374,246	
Advance and deposits	30,747		21,067	
Materials and supplies inventory	31,957		40,503	
Other Current assets	1,923		1,852	
Fuel for vessels	215,362		149,390	
Prepayments	6,941		4,045	
Total Current assets	16,589,588		13,790,941	
Reserved budget for vessel periodic maintenance	231,642		238,680	
Termination indemnity fund	2,521,454		2,388,245	
Long-term investments	284,456		273,933	
Other noncurrent assets	272,628		279,292	
Total Assets	19,899,768		16,971,091	
Less: Liabilities				
Accrued payable	583,728		724,593	
Contribution received in advance	1,419,906		1,352,868	
Fund held in trust	259,159		268,231	
Provision for termination indemnity	2,521,454		2,388,245	
Total Liabilities	4,784,247		4,733,937	
NET ASSETS	15,115,521		12,237,154	

Remark: 1/ The Difference of US$ 795,120 (US$ 13,032,274 – US$ 12,237,154) resulted from the change of rate in US$ translation.

Un-audited contribution received by SEAFDEC from Member Countries and other sources of funds for the year 2019 (In US$)

Sources	Secretariat	TD	MFRD	AQD	MFRDMD	IFRDMD	Total	
							In US$	%
Brunei Darussalam	7,000	-	-	-	-	-	7,000	0.05
Cambodia	12,000	-	-	-	-	-	12,000	0.09
Indonesia	52,000	-	-	-	-	588,825	640,825	4.66
Japan	280,000	-	-	-	-	-	280,000	2.04
Lao PDR	6,500	-	-	-	-	-	6,500	0.05
Malaysia	21,500	-	-	-	810,462	-	831,962	6.05
Myanmar	22,500	-	-	-	-	-	22,500	0.16
Philippines	25,000	-	-	5,431,026	-	-	5,456,026	39.69
Singapore	13,500	-	-	-	-	-	13,500	0.10
Thailand	33,000	3,549,765	-	-	-	-	3,582,765	26.07
Viet Nam	26,000	-	-	-	-	-	26,000	0.19
Sub-total	**499,000**	**3,549,765**		**5,431,026**	**810,462**	**588,825**	**10,879,078**	**79.15**
Other Sources [2/]	(8,155)	1,663,235[3/]	-	1,210,949	-	-	2,866,029	20.85
Total	**490,845**	**5,213,000**	**-**	**6,641,975**	**810,462**	**588,825**	**13,745,107**	**100.00**

Remarks:

[2/] Other sources of contributions include bank interests, gains/losses from varying exchange rates, contributions from donors directly given to Departments and miscellaneous receipts

[3/] Includes contributions in kind from JICA, Renovate M.V. SEAFDEC 2 = US$ 737,486.00

Other contributions received by SEAFDEC in 2019 (In US$)

Sources	Amount in US$ [4/]
Japanese Trust Fund (excluded: Japan-MRC=US$280,000)	1,550,357
Sweden	349,118
UNEP/GEF	726,534
Japan-ASEAN Integration Fund (JAIF) for EEL Project	168,570
Total	**2,794,649**

Remark:

[4/] Other sources of contribution which are not reported in the SEAFDEC Financial Statements.

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