

# FISH for the PEOPLE

A Special Publication for the Promotion of Sustainable Fisheries for Food Security in the ASEAN Region  
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## **SEAFDEC at 50: Pursuing the Viability of Regional Fisheries and Responding to the Sustainable Development Goals**



Southeast Asian Fisheries Development Center

# Editorial

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The Southeast Asian Fisheries Development Center (SEAFDEC) was established as a regional center for fisheries development to improve the food situation in Southeast Asia. Officially operational in December 1967, SEAFDEC was given the task of promoting, enhancing and managing fisheries development in Southeast Asia. In order to tap the vast marine fishery resources in Southeast Asian waters, the Marine Fisheries Training Department (TD) was established in Samut Prakan, Thailand to train fishers on modern fishing technologies, and the Marine Fisheries Research Department (MFRD) at Changi Point in Singapore to explore the fishing grounds and marine resources of the region. Later, the Aquaculture Department (AQD) was set up in the Philippines in 1973 to deal with freshwater and brackishwater fish culture. When MFRD lost its research vessel, the M.V. CHANGI, it pursued a new direction towards the development of technologies on safety and quality of fish and fishery products. The responsibility of conducting marine fishery resources surveys and oceanographic studies had since then been assumed by TD, while MFRD embarked on a post-harvest technology program on fish preservation and upgrading the quality of traditional fish products. In December 1990, the Marine Fishery Resources Development and Management Department (MFRDMD) was established in Chendering, Kuala Terengganu, Malaysia to assist the Member Countries towards the development and management of marine fishery resources in the waters of the Southeast Asian region. As attention given to inland fisheries escalated in view of its potential to supply fish for the growing food needs of the region's populace especially the rural poor,

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SEAFDEC established the Inland Fishery Resources Development and Management Department (IFRDMD) in Palembang, Indonesia in September 2014 to take charge of R&D activities that support the sustainable development and management of inland fisheries in the Southeast Asian region. Thus, SEAFDEC is now competent in working towards holistic approach to sustainable fisheries development and management in Southeast Asia, not only in marine capture fisheries, aquaculture, fisheries post-harvest technology, but also in inland capture fisheries.

In 1998, the SEAFDEC Council adopted the “SEAFDEC Strategic Plan” which outlined the future direction of SEAFDEC towards sustainable use of the region’s fishery resources. This paved the way for strengthening of the ASEAN and SEAFDEC collaboration for sustainable fisheries development in Southeast Asia. Such cooperation facilitated the efficient implementation of SEAFDEC programs and activities in the ASEAN Member States (AMSs), the results of which have provided inputs for the development of national policies and served as guide for the AMSs in the sustainable development of their respective fisheries. Therefore, for the past 49 years, while SEAFDEC has been implementing programs and activities in the AMSs and pursuing the viability of regional fisheries, it has also been adhering to the targets of **Sustainable Development Goal 14 to conserve and sustainably use the oceans, seas and marine resources for sustainable development**. Thus, food security and economic stability in the Southeast Asian region could be assured as SEAFDEC continues to sail swiftly beyond its 50<sup>th</sup> Anniversary in December 2017.

## C O N T E N T S

### Regional Initiatives

- Transforming Fisheries Development of Southeast Asia: SEAFDEC in Accord with the UN Sustainable Development Goals 2
- Improving Fisheries Management in Southeast Asia in Support of the Sustainable Development Goals 16
- The South China Sea Fisheries *Refugia* Initiative and the Sustainable Development Goals 22
- Highlighting SDG 14 in the Development and Management of Southeast Asian Marine Capture Fisheries 33
- Monitoring and Identification of Harmful Algal Blooms in Southeast Asia to Support SDG 14.1 39
- Development of a Sustainable Mangrove Crab Industry through Science-based Research 47

### Calendar of Events 52

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# Transforming Fisheries Development of Southeast Asia: SEAFDEC in Accord with the UN Sustainable Development Goals

Kom Silapajarn, Virgilia T. Sulit and Nualanong Tongdee

The idea of establishing the Southeast Asian Fisheries Development Center (SEAFDEC) was conceived during the First Ministerial Conference for Economic Development of Southeast Asia in April 1966 in Tokyo, Japan. During the said Conference, several regional concepts for agriculture and economic development were adopted including the establishment of a regional center for the promotion of fisheries as means of improving food situation in Southeast Asia. This paved the way for the unfurling of SEAFDEC in 1967 under the auspices of the Council of Ministers for the Economic Development of Southeast Asia.

Early on, the fishing industry in Southeast Asia was simple, where fishing activities were confined in near-shore areas using non-motorized or non-mechanized fishing boats, and the territorial seas lay only 12 nautical miles from shore. Fish landings were barely enough for domestic consumption although some countries attempted to produce fishery products for export. National planners viewed the fishery resources as inexhaustible and big national plans were made based on such perceptions. Many countries began to enhance their fishing capabilities using technologies transferred from the modern world, particularly in trawling to harvest as much fish as possible including sea bottom dwellers. Some Southeast Asian countries experienced the most successful results of the introduction of trawling leading to dramatic increases

in their respective fish landings. The region's national planners looked at the sea with much potential to be tapped. Heavy investments were made in terms of boats and fishing gear, then, returns of investment were proportional to increases in landings. All these efforts however, led to overfishing which became prominent as landings reached overall declines. Not obviously seen by national planners in the beginning until fishers started to feel the brunt of dwindling catch not only in terms of quantity but also in size. With too many fishing boats, fewer fish were caught, a situation that called for national planners to develop ways and means of properly managing and enhancing the fishery resources. As an answered prayer, SEAFDEC was established and became a reality.

Thus, started the era when fisheries development of Southeast Asia was transformed towards sustainability, and became aligned all the while, with the UN Sustainable Development Goal 14 or SDG 14 on the Conservation and Responsible Utilization of Lives below the Waters. While SEAFDEC continues to promote sustainable utilization and conservation of fishery resources in oceans, seas, rivers, lakes, wetlands and the like for food security in the Southeast Asian region, it also spotlights the other Sustainable Development Goals and their corresponding targets that interlink with the targets of SDG 14.

## Establishing a regional center for fisheries development in Southeast Asia

SEAFDEC was officially established as a regional center for fisheries development in Southeast Asia in December 1967, to promote, enhance and manage fisheries development in Southeast Asia for improving the region's food situation. Also in December 1967, the Agreement on the manner under which SEAFDEC would be organized and operated was finalized. Representatives from the Southeast Asian countries, duly authorized by their respective governments, approved and signed the *Agreement Establishing the Southeast Asian Fisheries Development Center* on 28 December 1967, namely: *H.E. M. Seki* for the Government of Japan; *H.E. R.H. Ho* for the Government of the Republic of Singapore; and *H. E. P. Sarasin* for the Government of the Kingdom of Thailand.

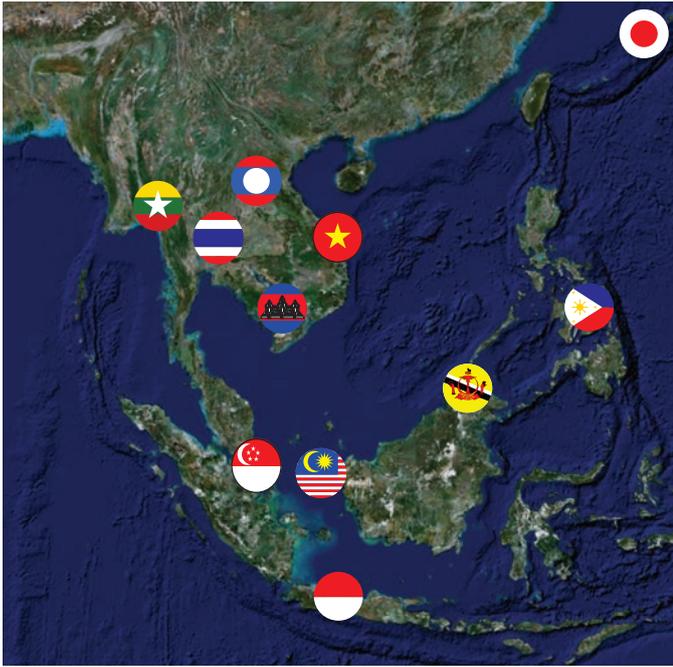
Subsequently, *H.E. President Ferdinand E. Marcos* signed the Agreement for the Government of the Republic of the Philippines, and *H. E. Tengku Ngah Mohamed* for the Government of Malaysia on 16 January 1968, while *H.E. D. Chinh* for the Government of the Republic of Viet-Nam

signed the Agreement on 26 January 1968. The Agreement includes provisions on the responsibilities and obligations of Governments hosting SEAFDEC Departments and those of the Government of Japan as a founding and donor Member Country.

The Agreement Establishing SEAFDEC also includes stipulations on the privileges, immunities and facilities to be accorded by the Member Governments to SEAFDEC, which are necessary to enable SEAFDEC to fulfill its objectives



1966 Ministerial Conference that led to the establishment of SEAFDEC



Member Countries of SEAFDEC

and carry out its functions efficiently. At the outset of its establishment, SEAFDEC had Japan, Malaysia, Philippines, Singapore, and Thailand, as its original Member Countries. In order that membership in SEAFDEC would cover the Southeast Asian countries, amendment was made to relevant articles in the Agreement Establishing SEAFDEC. The Protocol for effecting such amendment was signed by high officials from existing Member Countries in November 1994, paving the way for the admission of other Southeast Asian countries into SEAFDEC, namely: Brunei Darussalam, Indonesia, Cambodia, Lao PDR, Myanmar, and Viet Nam. To date, the Member Countries of SEAFDEC comprise all the ASEAN Member States (AMSs) and Japan.

## Unfolding the roles and functions of the SEAFDEC Technical Departments

To fulfill the task of SEAFDEC towards tapping the vast marine fishery resources in Southeast Asian waters, the **Marine Fisheries Training Department (TD)** was established in Samut Prakan Thailand in 1968 and the **Marine Fisheries Research Department (MFRD)** in Singapore a year later. TD was mandated to develop modern fishery technologies for better utilization of the marine resources, while MFRD was originally tasked to conduct research in marine fishery resources evaluation and oceanographic studies in the waters of the Southeast Asian region. To enable these two Departments to pursue their respective mandates, the Government of Japan donated in 1969, a fully-equipped 386-GT steel stern-trawler, the **M.V. Paknam** for TD to carry out its training activities onboard fishing vessel, and another fully-equipped 350 GT purse seiner, the **M.V. Changi** for MFRD to undertake fisheries research surveys in the Southeast Asian waters.



Few years later, the **Aquaculture Department (AQD)** was set up in the Philippines in 1973 for better management of fish harvests under controlled environments to enhance fish production, as production from marine resources had shown dwindling trend contrary to what had been originally thought of. When the M.V. Changi was out of commission in 1974, MFRD pursued a new direction towards the development of technologies on safety and quality of fish and fishery products. The responsibility of conducting marine fisheries resources surveys and oceanographic studies had since then been assumed by TD, while MFRD embarked on a post-harvest technology program focusing on fish preservation and upgrading the quality of traditional fish products. In order to reinforce the training facilities at TD, the Government of Japan donated to SEAFDEC in 1980 a 65-GT fiberglass purse seiner, the **M.V. Platoo**. In addition, TD also acquired in 1982 a 17-GT Thai-style trawler, the **M.V. Plalung**.



M.V. Paknam (top);  
M.V. Platoo (middle);  
and M.V. Plalung  
(left)

About a quarter of a century later, the **Marine Fishery Resources Development and Management Department (MFRDMD)** was established in Malaysia in 1992, to assist the Member Countries in the development and management of marine fishery resources in the waters of the Southeast Asian region. MFRDMD is specifically responsible for conducting research, training and dissemination of information 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, such as sharks and marine turtles.

In December 1992, a fully-equipped steel-framed 1178-GT training and research purse seine vessel, the **M.V. SEAFDEC**, was granted to SEAFDEC by the Government of Japan, for the conduct of marine fishery resources surveys in collaboration with the SEAFDEC Member Countries, in the South China Sea, Bay of Bengal, Andaman Sea, and the Gulf of Thailand. When the *United Nation's Convention on the Law of the Sea (UNCLOS)* was signed in 1982 and came into force in 1994, signaling the opportunity for countries to extend their Exclusive Economic Zones (EEZs) to 200 nautical miles from shore, and as UNCLOS called for sustainable management and enhancement of the fishery resources, this new paradigm of development was adopted by SEAFDEC in pursuing its future research and development efforts. The roles of TD have been refocused towards the development of responsible fishing practices as well as on promotion of coastal and inshore fisheries management to assist the Southeast Asian countries in managing their respective small-scale fisheries to ensure stable supply of fish for food security in the Southeast Asian region. For its part, AQD continued to pursue programs on

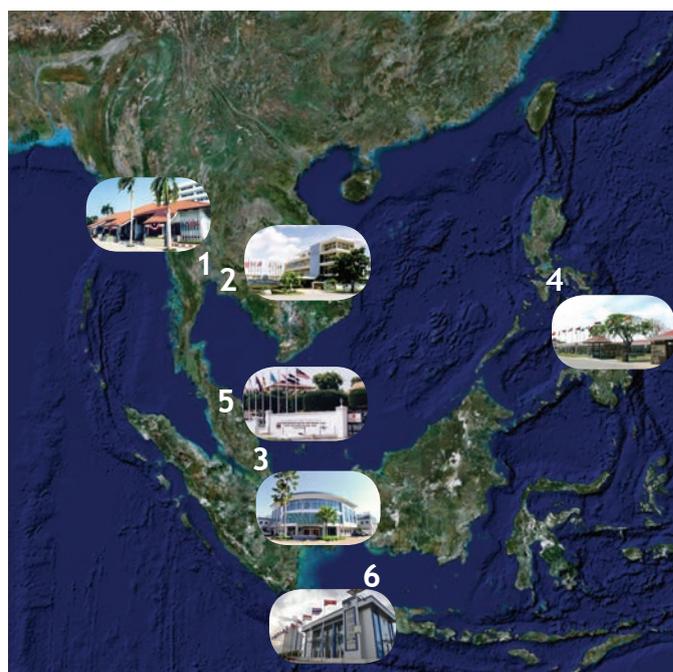
sustainable development and responsible stewardship of aquaculture resources in Southeast Asia through research and promotion of appropriate aquaculture technologies and socio-economic strategies relevant to the sustainability of the region's aquaculture sector.

Considering the need to replace the aging M.V. Platoo, the Government of Japan donated to SEAFDEC in 2003 a 221-GT research and training vessel, the **M.V. SEAFDEC 2** under the Japanese Grant Aid to Eligible Countries. Since 2004, the vessel has been conducting fishery resources and oceanographic surveys in the waters of Southeast Asia in collaboration with the AMSs.

Throughout the years, attention given to inland fisheries had escalated in view of its potential to supply fish for the growing food needs of the region's populace especially the rural poor. Continued discussions on sustainable fisheries in the Southeast Asian region therefore included the need for SEAFDEC to address the region's concern on the responsible utilization and conservation of inland water fishery resources. Thus, SEAFDEC formally established the **Inland Fishery Resources Development and Management Department (IFRDMD)** in Palembang, Indonesia in September 2014 to pave the way for the SEAFDEC to become competent in working towards a holistic approach to sustainable fisheries development and management in Southeast Asia, not only in marine capture fisheries, aquaculture, fisheries post-harvest technology, but also in inland capture fisheries. IFRDMD takes charge of R&D activities that support the sustainable development and management of inland fisheries in the Southeast Asian region.



M.V. SEAFDEC (top) and M.V. SEAFDEC 2 (below)



SEAFDEC Secretariat and Departments: (1) Secretariat, Bangkok, Thailand; (2) TD, Samut Prakan, Thailand; (3) MFRD, Singapore; (4) AQD, Iloilo, Philippines; (5) MFRDMD, Terengganu, Malaysia; (6) IFRDMD, Palembang, Indonesia

## Overseeing the management of SEAFDEC

In accordance with the Agreement Establishing SEAFDEC, the Secretary-General is the Chief Executive of the Center, and is responsible to the governing body, the SEAFDEC Council of Directors. The Agreement further stipulates that the Secretary-General and Deputy Secretary-General shall be concurrently the Chief and Deputy Chief of one of the Departments, and throughout the years, this Department is the Training Department (TD). However, the need to set up an independent Secretariat was deemed necessary as SEAFDEC expanded its operations and necessitated to strengthen management of the Center. With the agreement that the Secretariat should be located separately from the Departments, the **Secretariat of SEAFDEC** was then moved to a new building provided by the Department of Fisheries of Thailand at Kasetsart University Campus in Bangkok, Bangkok in 1997. Since then, its new premises had been serving as the Headquarters for SEAFDEC administration and management.



SEAFDEC Headquarters at the Department of Fisheries compound in Kasetsart University Campus, Bangkok, Thailand

## Establishing the Strategic Vision for fisheries development in the Southeast Asian region

The future direction of SEAFDEC that takes into consideration the sustainable use of regional fishery resources, was outlined in the *SEAFDEC Strategic Plan* adopted by the SEAFDEC Council in 1998, which also stipulated the need to strengthen collaboration between ASEAN and SEAFDEC for sustainable fisheries development in Southeast Asia. Through the SEAFDEC Strategic Plan, implementation of projects and activities in the region had been harmonized and coordinated to respond to the changing paradigm in fisheries management and requirements of the SEAFDEC Member Countries. This led to the establishment in 1998 of the **ASEAN-SEAFDEC Fisheries Consultative Group (FCG)** as a mechanism for the ASEAN and SEAFDEC to address the regionally important issues and actions in sustainable fisheries development.

During the same period, the Government of Japan shifted its Official Development Assistance rendered to SEAFDEC from the Ministry of Foreign Affairs through Japan International Cooperation Agency (JICA) to the Japanese Trust Fund (JTF) Program of the Fisheries Agency of Japan. SEAFDEC pursued the implementation of regional fisheries projects aimed at promoting the development of sustainable fisheries in the Southeast Asian region with financial assistance from Japan that was channeled through the JTF. Under the FCG mechanism, SEAFDEC has been implementing programs and activities in the Southeast Asian countries that led to various achievements attained through rigorous research works, human resource development, information exchange and dissemination, and regional clarification of internationally-important fisheries issues. Such achievements have been recognized not only as regional initiatives but also used as basis for the formulation of national policies by the countries.

Considering the need to concretize the collaborative mechanism between the ASEAN and SEAFDEC to make sure that there is greater integration of ASEAN and SEAFDEC fisheries programs thereby avoiding duplication and enabling better utilization of resources, the ASEAN and SEAFDEC signed the Letter of Agreement on **ASEAN-SEAFDEC Strategic Partnership (ASSP)** in November 2007. This provided the framework for closer ASEAN-SEAFDEC cooperation in strengthening fisheries development for food security and poverty eradication in the region. Under the ASSP, SEAFDEC serves as the executing agency for the ASEAN in the implementation of fisheries programs in the AMSs, and assists the ASEAN in the formulation and implementation of fisheries policies and programs/activities that could address issues and concerns on fisheries under the ASEAN Economic Community.

## Pursuing quality technologies

SEAFDEC upholds the development and promotion of quality technologies in fisheries and aquaculture in the Southeast Asian region that transformed fisheries and aquaculture development towards sustainability. This quantum leap to quality technologies is an epic that revolutionizes the fisheries and aquaculture programs of SEAFDEC as it continues to



Bountiful harvest of unicorn leatherjacket fish (*Aluterus monoceros*) from Malaysian waters, especially in Terengganu State

**Table 1.** Fishery production of Southeast Asian countries by sub-sector from 2005-2014 (in million metric tons)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Marine Capture Fisheries	13.59	13.94	14.06	13.81	14.14	14.87	15.10	15.59	16.26	16.66
Inland Capture Fisheries	1.89	2.13	2.00	2.33	2.40	2.38	2.64	2.82	2.88	3.03
Aquaculture	7.51	8.43	9.24	11.06	12.38	14.19	15.75	21.16	20.90	22.53
<b>Total (Southeast Asia)</b>	<b>22.99</b>	<b>24.50</b>	<b>25.30</b>	<b>27.20</b>	<b>28.92</b>	<b>31.44</b>	<b>33.49</b>	<b>39.57</b>	<b>40.04</b>	<b>42.22</b>
<b>Total (World)*</b>	<b>151.4</b>	<b>152.9</b>	<b>156.8</b>	<b>160.1</b>	<b>164.3</b>	<b>168.2</b>	<b>177.3</b>	<b>182.4</b>	<b>191.1</b>	<b>195.7</b>

Source of Southeast Asian data: Fishery Statistical Bulletin for the South China Sea Area 2005-2007 (SEAFDEC, 2005-2010a) and Fishery Statistical Bulletin of Southeast Asia 2008-2014 (SEAFDEC 2010b-2016)

\*Source: FAO Fisheries and Aquaculture Information and Statistic Service

expand covering all aspects of fisheries, from marine capture to fish processing, aquaculture, and inland capture fisheries. While fisheries development in the past 30 or 40 years focused mainly on maximizing production particularly from capture fisheries, the development trend during the recent decade had been shifted towards ensuring the sustainable utilization of the region's fishery resources. The current fisheries production of Southeast Asia which annually contributed more than 19% to the global fishery production during the past ten years (Table 1), makes fisheries one of the very important sectors in the region, not only for national economic development and employment opportunities, but more importantly for its contribution to food security and the well-being of peoples of the Southeast Asian region.

Fisheries of the Southeast Asian region are characterized as multi-species, multi-gear and involve large numbers of fishers mostly engaged in small-scale operations, and the fishery resources is openly accessible to numerous users. This situation has created difficulties in promoting responsible fisheries in response to the requirements of international and regional fisheries policies and management efforts. In order to

address such issues, SEAFDEC initiated the *Regionalization of the FAO Code of Conduct for Responsible Fisheries (CCRF)* that also facilitated the adoption of the CCRF by the AMSs for the sustainable development and management of their respective fisheries (SEAFDEC, 2000; SEAFDEC, 2003; SEAFDEC, 2005a; SEAFDEC, 2005b; SEAFDEC, 2006). The efforts in promoting the adoption of the CCRF in the Southeast Asian region had earned for SEAFDEC the prestigious **Margarita Lizárraga Award for the Biennium 2006-2007** awarded by FAO in 2007.



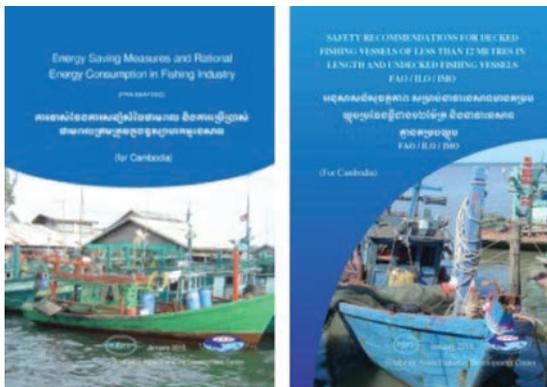
With technical support from SEAFDEC, several countries in the region therefore improved their fisheries management particularly for small-scale fisheries through the introduction of management concepts such as co-management and community-based management, to gradually replace the open access to fisheries with controlled and limited access. Several countries have also been moving towards balancing the utilization of fish with the available resources through management of fishing capacity. Ecosystem approach to

The Regional Guidelines for Responsible Fisheries in Southeast Asia series, and the Margarita Lizarraga Award Medal for the Biennium 2006-2007 given to SEAFDEC

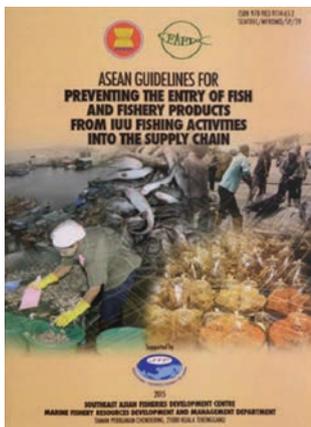
fisheries management has also been promoted to ensure that fisheries management takes into consideration, and balances the need from various aspects including the non-fisheries sub-sectors, and is undertaken with full involvement of wide range of stakeholders.

Meanwhile, the continued promotion of responsible fishing technologies and practices by TD, led to the development of several measures and regulations that have been adopted by the countries in the region, such as restrictions on the use of fishing gears and closure of fishing areas and seasons, to ensure the sustainable exploitation of the fishery resources. Specifically for commercial fisheries, fishing gears and equipment have to be developed or modified to ensure selectivity of the gears and reduce the number of fishing crew onboard the vessels.

New design of fishing vessels has been considered so that that the requirements for better working conditions of fishers onboard is assured. Efficient energy use in fishing operations has also been promoted in the AMSs while issues on safety at sea, as well as working conditions onboard fishing vessels are being addressed for the sustainability of fishing operations in the future. Concerns on low quality of catch onboard the fishing vessels, have also been dealt with to enhance utilization of catch for human consumption and subsequently improve the returns and benefits that could be obtained by fishers.



Concerns on the illegal, unreported and unregulated (IUU) fishing, which is one of the major threats to sustainable fisheries development in the region, have also been addressed by SEAFDEC. While national initiatives in combating IUU fishing had been undertaken by the respective countries, the *ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain* (SEAFDEC/MFRDMD, 2015) has been developed and is now being



promoted in the region. The implementation of actions toward combating IUU fishing has been supported by various tools at regional level, such as the *Regional Fishing Vessels Record (RFVR)* for fishing vessels 24-meter in length and over (Saraphaivanich *et al.*, 2016), the *Regional Collaboration for the Implementation of Port State Measures* (SEAFDEC/TD, 2016), *Regional Plan of Action for the Management of Fishing Capacity: RPOA-Capacity* (Amornpiyakrit and Siriraksohon, 2016), as well as the development and implementation of *ASEAN Catch Documentation Scheme* (Siriraksohon *et al.*, 2016).

MFRD had been promoting sustainable post-harvest processing technologies with the objectives of preserving the catch for year-round consumption, addressing consumers' preference by enhancing product variety through value-adding, and improving the values of catch and returns to fishers and the fishing communities. In addition, standard methodologies for achieving food safety of fishery products had been developed and disseminated to the countries in the region to ensure that the products are safe for human consumption not only for international but also for domestic markets. Thus, the development of appropriate post-harvest technologies not only help enhance food safety, food security and competitiveness of products from the region, but also allow the harvested catch to be fully utilized, and at the end reduce fishing pressures on the limited fishery resources.

In order to obtain better understanding on the status of the fisheries resources as this could serve as scientific basis for sustainable fisheries management, MFRDMD has been exerting efforts to improve technical and scientific information, from data collection, analysis, interpretation and presentation, to create better understanding of the current situation as well as on the status and trend of the fisheries. For aquaculture, significant developments had been attained by AQD through the development of technologies for important aquaculture species; promotion of good aquaculture practices including environmental-friendly aquaculture technologies; ensuring the quality and safety of aquaculture products through the appropriate use of chemicals and drugs, proper fish health management including development of regional disease surveillance system; and improvement of traceability to ensure safety and facilitate trading of aquaculture products.

Concerns on continued use of by-catch and low-value fish as feed for aquaculture that on one hand could increase aquaculture production but on the other



hand, create considerable pressure to capture fishery resources and to food security as a whole, are being dealt with through research activities on the use of locally available plant-based ingredients as alternative sources of protein to make the aquaculture feed industry no longer be dependent solely on fish-based ingredients in the future. In addition to direct production of aquaculture commodities, aquaculture technologies could also be applied to support resources enhancement.

Difficulties in data collection on inland capture fisheries that result in statistics under-representation due to the nature of fisheries with large quantity of catches goes to household consumption are being tackled by SEAFDEC through its IFRDMD. Another issue being considered is the disconnectivity of habitats caused not only by construction of large-size hydropower dams, but also small-head weirs for irrigation purposes or even road construction affecting the survival of species particularly those that migrate during certain stages of their life cycles. In Southeast Asia, the compilation of statistics at regional level has been harmonized by SEAFDEC with inputs from countries in the region. It is therefore a big challenge for countries to enhance their systems of collecting fishery data and information in order to ensure that such data are accurate and reliable, and could serve as a basis for policy planning and management of fisheries.

Moreover, areas that are being addressed by SEAFDEC include conservation and rehabilitation of habitats, restoration of fishery resources and habitats such as through stock release, and the establishment of fish *refugias* as conservation areas, particularly during the critical stage of life cycle of important aquatic species. Issues on the impacts of climate change are also being dealt with as fishers and fishery communities are among the first groups that would be impacted from adverse climate events.

## Shaping national fishery policies in the ASEAN Member States

After the regionalization of the CCRF, SEAFDEC initiated a series of consultative processes to look at the CCRF from the Southeast Asian context and at the same time strengthen



the collaboration between the ASEAN and SEAFDEC for the sustainable development of fisheries in the region. Results from such fora led to adoption in 2001 of the **Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region** (SEAFDEC, 2001) and the subsequent **Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020** in 2011 (SEAFDEC, 2011) providing the common fisheries policy framework and policy actions for the sustainable development of fisheries in the Southeast Asian region. Midway during the aforementioned ten-year period, the **SEAFDEC Program Framework** was adopted by the SEAFDEC Council of Directors in 2009, and used by SEAFDEC in harmonizing and enhancing its programs and activities implemented in the Southeast Asian region.



## Adjusting to the changing paradigm in fisheries development

While carrying out various activities in accordance with the series of Resolutions and Plans of Action, the Southeast Asian region continued to confront emerging issues and proposed for closer cooperation between SEAFDEC and the ASEAN to address their concerns, the most recent of which includes the stringent requirements of importing countries on export of fish and fishery products making sure that these are derived from responsible fishing practices and do not come from IUU fishing. Therefore, before reaching 2020, SEAFDEC considered it as an opportune time to conduct in 2016 an in-depth review of the emerging regional issues that hinder fisheries development and hamper the competitiveness of fish and fishery products from the region. As this requires identification and adoption of practical and harmonized approaches to ensure that the region's fish and fishery products do not come from IUU fishing and their competitiveness in the domestic and world markets is enhanced, the ASEAN and SEAFDEC organized the **High-level Consultation on Regional Cooperation in Sustainable Fisheries Development Towards the ASEAN Economic Community: Combating IUU Fishing and Enhancing the Competitiveness of ASEAN Fish and Fishery Products in**



August 2016. The High-level Consultation adopted the *Joint ASEAN-SEAFDEC Declaration on Combating IUU Fishing and Enhancing the Competitiveness of ASEAN Fish and Fishery Products* (SEAFDEC, 2016) which signifies ASEAN solidarity towards combating IUU fishing and enhancing the competitiveness of fish and fishery products from the Southeast Asian region.

## SEAFDEC and the Sustainable Development Goals

Based on the foregoing account of SEAFDEC programs and activities, it is clear that SEAFDEC has always been working towards the sustainability of fisheries in the Southeast Asian region. The various significant outputs from such SEAFDEC programs and activities (**Box 1**) point to the same aspects as in the Sustainable Development Goals (SDGs), more particularly SDG 14 (**Box 2**).

Specifically, one of the initiatives undertaken by SEAFDEC was the implementation of the project on the **Promotion of “One Village, One Fisheries Product” System to Improve the Livelihood of the Fisheries Communities in the ASEAN Region** or **FOVOP**, which primarily aimed to pave the way for the promotion of alternative livelihoods to mitigate poverty in the fishing communities. The project, which is clearly along the targets of SDG 1, SDG 2 and SDG 14, specifically aimed to support the AMSs in their efforts towards sustainable development of fisheries for food security and poverty alleviation.

Most AMSs have been improving their respective fisheries management systems to alleviate poverty, which continues to prevail in the region’s fishing communities. The promotion

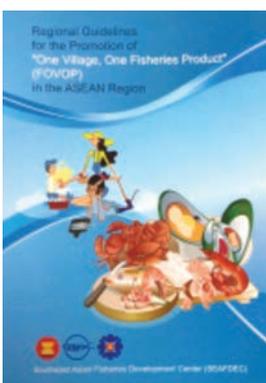
of the FOVOP System was considered by SEAFDEC as a strategy to address such concern by developing the *Regional Guidelines for the Promotion of “One Village, One Fisheries Product” (FOVOP) in the ASEAN Region* (SEAFDEC, 2010).

Currently, SEAFDEC is implementing programs and projects classified into Program Thrusts of SEAFDEC, which was adopted by the SEAFDEC Council in 2007 as well as Special Projects, Departmental Programs and Other Programs (**Box 3**). Most of these programs and projects are in line with the targets of SDGs, especially SDG 14.

Meanwhile, the activities of SEAFDEC through its Program Thrusts that respond to the SDGs are summarized in **Box 4** (Paterson, 2017). Specifically, seven of the 17 SDGs are addressed by the activities of SEAFDEC under its Program Thrusts where Goals relating to Responsible Production and Consumption (**SDG 12**) and Life below Water (**SDG 14**) are focused in all the Program Thrusts, while Thrusts I and III aim to approach the Goals on No Poverty (**SDG 1**), No Hunger (**SDG 2**), and Good Jobs and Economic Growth (**SDG 8**), considering that the main objectives of Thrusts I and III include the promotion of responsible fisheries for poverty alleviation and the improvement of management concepts and approaches for sustainable fisheries. Moreover, the Special Projects add significant potential value in terms of contributions towards the Goals on Gender Equality (**SDG 5**) and Climate Action (**SDG 13**).

## Way Forward

For the past 49 years, SEAFDEC through its Secretariat and technical Departments, namely: TD, MFRD, AQD, MFRDMD, and IFRDMD, implement programs and activities that lead to the development of national policies serving as guides for the Southeast Asian countries in the sustainable development of their respective fisheries. As SEAFDEC continues to attain technological advances and disseminating the developed technologies to its Member Countries, it is also looking beyond the horizon to explore new frontiers and new resources for expanding its efforts towards the sustainability of fisheries. SEAFDEC would also continue to adhere to the strategic plans of the ASEAN towards



FOVOP Guidelines (*left*) and fishery products commonly found in local markets of the AMSs (*right*)

## Box 1. Significant outputs from SEAFDEC programs and activities responding to the SDGs

### Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020

The “Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020” were adopted by the Ministers and Senior Officials responsible for fisheries of the ASEAN-SEAFDEC Member Countries during the ASEAN-SEAFDEC Conference “Fish for the People 2020: Adaptation to a Changing Environment” in 2011. The Resolution and Plan of Action that comprises sections on Planning and Information; Fisheries Management; Aquaculture; Optimal Utilization of Fish and Fishery Products; Fish Trade; and Regional and International Policy Formulation, have been serving as policy frameworks for the implementation of activities by the countries in the region toward enhancing the sustainability of fisheries and its contribution to food security and poverty alleviation.

### Regional Guidelines for the Promotion of Responsible Fisheries in Southeast Asia

Implementation of responsible fisheries is crucial for ensuring the sustainability of fisheries especially in the Southeast Asian region. Since 1995, FAO has promoted the adoption of the Code of Conduct for Responsible Fisheries (CCRF) at the global level. In order to address the specificities of fisheries in Southeast Asia and encourage the countries to adopt the CCRF, SEAFDEC in cooperation with the Member Countries regionalized the CCRF, and came up with a series of “Regional Guidelines for Responsible Fisheries in Southeast Asia”, namely: Responsible Fishing Operations; Responsible Aquaculture; Responsible Fisheries Management; and Responsible Post-harvest Practices and Trade. In addition, Supplementary Guidelines on Co-management Using Group User Rights, Fishery Statistics, Indicators and Fisheries *Refugia* were also developed to assist the countries in adopting the most practical national systems on various aspects of fisheries to improve management through a responsible approach.

### Regional Guidelines for the Promotion of “One Village, One Fisheries Product” in the ASEAN Region

SEAFDEC in collaboration with the ASEAN Member States developed the “Regional Guidelines for the Promotion of “One Village, One Fisheries Product” (FOVOP) in the ASEAN Region” to provide a common framework for the countries in the region in promoting and bringing about a “One Village, One Fisheries Product” concept. Endorsed by the 42<sup>nd</sup> SEAFDEC Council and the 18<sup>th</sup> ASWGF in 2010, this initiative could serve as a means of creating economic activities in rural communities, specifically in carrying out alternative and supplemental livelihoods to alleviate poverty. At the same time, the initiative is anticipated to help in reducing fishing pressure and contributing to sustainable fisheries development and management as well as food security in the region.

### Recommendations on Chemical Use in Aquaculture in Southeast Asia

The use of chemicals in aquaculture has become necessary to prevent and control diseases of farmed aquatic animals, or in some cases chemicals are added in feeds or feed ingredients as chemotherapeutic agents, as preservatives or as adulterants. To protect consumers from the adverse effects of residual chemicals in farmed aquatic species and to satisfy safety regulations imposed by importing countries, SEAFDEC/AQD has determined the withdrawal periods of commonly used antibiotics in aquatic species cultured in the region. Given such a scenario, AQD has also advocated for the accessibility of regulated chemical products that are safe and effective for fish farmers to use; and for fish farmers to apply such chemicals in manners consistent with their intended use, adopt best management practices, and follow relevant rules and regulations that aim to maintain environmental integrity and ensure the sustainability of their aquaculture operations.

### Regional Guidelines on Traceability System for Aquaculture Products in the ASEAN Region

In view of the significant volume of aquaculture fish and fishery products exported annually by the AMSs to regional and global markets, traceability of such products has become necessary especially for the export of these products to major markets, e.g. Japan, the European Union (EU) and USA. Such international requirements together with an increasing consumer awareness and demand for products that assure food safety, security and sustainability, have called for reliable traceability system to be established to ensure the sustainable development of the aquaculture industry. SEAFDEC/MFRD in close collaboration with the ASEAN-SEAFDEC Member Countries therefore developed the draft “Regional Guidelines on Traceability System for Aquaculture Products in the ASEAN Region” (SEAFDEC, 2016), which was endorsed by the 48<sup>th</sup> Meeting of the SEAFDEC Council and the 24<sup>th</sup> Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGF) in 2016.

### Regional Plan of Action of Sea Turtle Foraging Habitats in Southeast Asian Waters

The “Regional Plan of Action of Sea Turtle Foraging Habitats in Southeast Asian Waters” was developed by SEAFDEC/MFRDMD in collaboration with the Southeast Asian countries that have sea turtles landing and nesting on their beaches. This Regional Plan of Action is intended to ensure that sea turtles and the ecosystem of their foraging habitats are well managed and protected, and poaching of sea turtle eggs in nesting areas are reduced (Mahyam Mohd. Isa *et al.*, 2008). The Regional Plan of Action outlines the possible future actions, expected outputs and indicators in achieving objectives of protecting and conserving sea turtle foraging habitats; reducing direct and indirect causes of sea turtle mortality in foraging habitats; strengthening research and monitoring in sea turtle foraging habitats; enhancing community participation that may have direct impact on foraging habitats through information dissemination and education; strengthening integrated management of sea turtles at foraging habitats; and securing funding support for sea turtle conservation and management. The Regional Plan of Action was endorsed by the 17<sup>th</sup> FCG/ ASSP Meeting in 2014.

### Regional Policy Recommendations on Conservation and Management of Eel Resources and Promotion of Sustainable Aquaculture

The Regional Policy Recommendations on Conservation and Management of Eel Resources and Promotion of Sustainable Aquaculture were developed by SEAFDEC/IFRDMD and AQD, comprising action plans necessary for managing the utilization of eel resources and advancing eel aquaculture to eliminate illegal export of elvers and juvenile eels from the Southeast Asian countries. Based on results from surveys on eel (including glass eel) catch, commercial distribution and trade conducted in the region as well as scientific study on taxonomy of eel and development of data collection methodologies, information on the status of eel resources would be obtained to serve as basis for sustainable utilization of eels in the Southeast Asian region.

### Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region

The Regional Plan of Action (RPOA) on Sustainable Utilization of Neritic Tunas in the ASEAN Region elaborates the action plans necessary for determining the available data and information, improving data collection and developing key indicators; improving sustainable fisheries management; improving sustainable interaction between fisheries and marine ecosystem; improving compliance to rules and regulations and access to markets; addressing social issues; and enhancing regional cooperation. The “RPOA-Neritic Tunas” was endorsed for adoption in the region by the 47<sup>th</sup> Meeting of the SEAFDEC Council and the 23<sup>rd</sup> Meeting of ASWGF in 2015 (SEAFDEC, 2015).

## Box 1. Significant outputs from SEAFDEC programs and activities responding to the SDGs (Cont'd)

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

The ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain is based on principles in relevant international and regional instruments, with the objective of ensuring that fish and fishery products from the region entering global supply chain do not come from IUU fishing activities, thus enhancing the credibility and competitiveness of the products. The Guidelines identified measures to be undertaken by countries, which include managing fishing activities within a country; regulating transshipment and landing of fish/catch across borders; preventing poaching in the EEZs of other countries; controlling illegal fishing and trading practices of live reef food fish, reef-based ornamental and endangered aquatic species; and strengthening the management of fishing in the high seas and RFMO areas. The Guidelines was endorsed by the 47<sup>th</sup> Meeting of the SEAFDEC Council and the 23<sup>rd</sup> Meeting of ASWGF in 2015 for subsequent implementation in the region.

### Regional Fishing Vessels Record (RFVR) for Vessels 24 m in Length and Over

The Regional Fishing Vessels Record (RFVR) is a collaborative initiative of the AMSs to facilitate sharing of information among AMSs on fishing vessels engaged in “International Fishing Operations” or those fishing operations in foreign countries’ EEZ or in the high seas. Covering initially fishing vessels 24 meters in length and over, the RFVR serves as practical tool for related authorities of AMSs to check and take corrective actions against inappropriate behavior of fishing vessels, thereby supporting all efforts to eliminate IUU fishing in the Southeast Asian region.

### ASEAN Catch Documentation Scheme (ACDS): A tool for enhancing trade and combating IUU fishing in the Southeast Asian region

The ASEAN Catch Documentation Scheme (ACDS) is being developed to serve as tool for enhancing the traceability of fish and fishery products from the AMSs bound for intra-regional and international trade, and prevent the entry of fish and fishery products from IUU fishing activities into the supply chain of the AMSs. Focusing on marine capture fisheries at the initial stage, the ACDS delineates the catch flow and movement with agreed schemes for: Catch Declaration/Logbook/Logsheet (CD); Movement Document (MD); and ASEAN Catch Certification (ACC) for Exportation. While the Processing Statement for Re-exportation is necessary for imported fish before processing, the ACDS also includes Re-export Certificate for imported fish that are not to be processed. Such schemes would be made applicable for either large or small size fishing vessels in the region.

### Regional Plan of Action for the Management of Fishing Capacity in the ASEAN Region

The Regional Plan of Action for the Management of Fishing Capacity in the ASEAN Region (RPOA-Capacity) is being formulated considering that management of fishing capacity is one of the key elements that ensure sustainable utilization of fishery resources. The RPOA-Capacity is intended to provide guidance to the AMSs in formulating policies and providing enabling environment for effective management of fishing capacity at the national level, by eliminating excess fishing capacity and ensuring that levels of fishing effort are commensurate with sustainable use of fishery resources. The RPOA-Capacity also stipulates the need to strengthen sub-regional and regional cooperation in managing fishing capacity, particularly for the areas where trans-boundary management are required, such as in the Gulf of Thailand, Andaman Sea, Sulu Sulawesi Seas, and other sub-regional areas of Southeast Asia.

## Box 2. The Sustainable Development Goals (SDGs) with focus on SDG 14

**SDG 1: No Poverty** - End poverty in all its forms everywhere

**SDG 2: Zero Hunger** - End hunger, achieve food security and improved nutrition and promote sustainable agriculture

**SDG 3: Good Health and Well-being** - Ensure healthy lives and promote well-being for all at all ages

**SDG 4: Quality Education** - Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

**SDG 5: Gender Equality** - Achieve gender equality and empower all women and girls

**SDG 6: Clean Water and Sanitation** - Ensure availability and sustainable management of water and sanitation for all

**SDG 7: Affordable and Clean Energy** - Ensure access to affordable, reliable, sustainable and modern energy for all

**SDG 8: Decent Work and Economic Growth** - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

**SDG 9: Industry, Innovation and Infrastructure** - Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

**SDG 10: Reduced Inequalities** - Reduce income inequality within and among countries

**SDG 11: Sustainable Cities and Communities** - Make cities and human settlements inclusive, safe, resilient and sustainable

**SDG 12: Responsible Consumption and Production** - Ensure sustainable consumption and production patterns

**SDG 13: Climate Action** - Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy

**SDG 14: Life Below Water** - Conserve and sustainably use the oceans, seas and marine resources for sustainable development

14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans

14.3 Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels

### Box 2. The Sustainable Development Goals (SDGs) with focus on SDG 14 (Cont'd)

14.4	By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics
14.5	By 2020, conserve at least 10 percent of coastal and marine areas, consistent with national and international law and based on the best available scientific information
14.6	By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation
14.7	By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism
14.a	Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries
14.b	Provide access for small-scale artisanal fishers to marine resources and markets
14.c	Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of "The Future We Want"
<b>SDG 15: Life on Land</b> - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	
<b>SDG 16: Peace, Justice and Strong Institutions</b> - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	
<b>SDG 17: Partnerships for the Goals</b> - Strengthen the means of implementation and revitalize the global partnership for sustainable development	

fisheries development as its contribution to the integration of fisheries in the ASEAN Economic Community, thus, ensuring food security and economic stability in the Southeast Asian region. As SEAFDEC celebrates its Golden Anniversary in December 2017, it continues to be committed in enhancing the benefits that its Member Countries could obtain from its R&D activities. However, SEAFDEC would also need the enhanced cooperation of the Member Countries in developing its strategic vision beyond the 50 years of its existence.

As SEAFDEC is entering the threshold of its 50<sup>th</sup> Anniversary and taking the opportunity of the occasion as a platform to guide SEAFDEC towards its future direction, the SEAFDEC Program Committee during its 39<sup>th</sup> Meeting in 2016 suggested that a **Special SEAFDEC Council Meeting** should be organized with the objective of setting the future direction of SEAFDEC beyond its 50<sup>th</sup> year. SEAFDEC was therefore requested to prepare a draft of its desired future direction

based on the aforementioned background information for consideration by the SEAFDEC Council at its next Meeting in 2017 to facilitate speedy adoption during the aforesaid Special SEAFDEC Council Meeting.

Against the backdrop of the **UN Sustainable Development Goals**, the Draft Resolution on the Future of SEAFDEC: Functions, Vision, Mandate and Strategies Towards 2030 was therefore developed taking into account the Prioritized Issues for Future Regional Program Formulation adopted during the 46<sup>th</sup> Meeting of the SEAFDEC Council in 2014, and the Plans of Operation and Programs of Work of all SEAFDEC Departments and Secretariat adopted by the 47<sup>th</sup> Meeting of the SEAFDEC Council in 2015. The existing mandate of SEAFDEC adopted in 2009 that aims "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

### Box 3. SEAFDEC Programs and Projects (2016-2017) and the SDGs

Programs based on the SEAFDEC Program Framework	Lead Department	SDG Targets
<b>Thrust I: Developing and Promoting Responsible Fisheries for Poverty Alleviation &amp; Food Security</b>		
1. Human Resource Development for Sustainable Fisheries	TD	14.a
2. Optimizing Energy Use/Improving Safety Onboard in Fishing Activities	TD	14.b
3. Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia	TD	14.2
4. Environment-friendly, Sustainable Utilization and Management of Fisheries and Aquaculture Resources	AQD	14.1
5. Enhancement of Sustainability of Catadromous Eel Resources in Southeast Asia	IFRDMD	-
6. Promotion of Responsible Utilization of Inland Fisheries in Southeast Asia	IFRDMD	14.b
Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management	MFRDMD	14.b

**Box 3. SEAFDEC Programs and Projects (2016-2017) and the SDGs (Cont'd)**

<b>Programs based on the SEAFDEC Program Framework</b>	<b>Lead Department</b>	<b>SDG Targets</b>
<b>Thrust II: Enhancing Capacity &amp; Competitiveness to Facilitate International and Intra-regional Trade</b>		
7. 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	MFRD	14.1
8. Cold Chain Management for Seafood	MFRD	-
9. Reinforcement and Optimization of Fish Health Management and the Effective Dissemination in the Southeast Asian Region	AQD	-
<b>Thrust III: Improving Management Concepts and Approaches for Sustainable Fisheries</b>		
10. Strategies for Trawl Fisheries By-catch Management	TD	14.4
11. Promotion of Counter Measures to Reduce IUU fishing activities	TD	14.4
12. Combating IUU Fishing in the Southeast Asian Region through Application of Catch Certification for Trading of Fish and Fishery Products	MFRDMD	14.4
13. Establishment and Operation of a Regional System of Fisheries <i>Refugia</i> in the South China Sea and Gulf of Thailand	TD	14.2
<b>Thrust IV: Providing Policy &amp; Advisory Services for Planning &amp; Executing Management of Fisheries</b>		
14. Fisheries Resource Survey and Operational Plan for M.V. SEAFDEC 2	TD	-
15. Offshore Fisheries Resources Exploration in Southeast Asia	TD	-
16. Enhancing the compilation and Utilization of Fishery Statistics and Information for Sustainable Development and Management of Fisheries in Southeast Asian Region	TD/SEC	14.c
17. Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region	MFRDMD	14.c
18. Research for Enhancement of Sustainable Utilization and Management of Sharks and Rays in the Southeast Asian Region	MFRDMD	14.a
<b>Thrust V: Addressing International Fisheries Related Issues from a Regional Perspective</b>		
19. Assistance of Capacity Building in the Region to Address International Trade Related Issues	SEC	14.a
20. Strengthening SEAFDEC Network for Sustainable Fisheries	SEC	-
<b>Special Projects</b>		
1. Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia	SEC	14.2, 14.3
2. USAID-SEAFDEC "Oceans and Fisheries Partnership"	SEC	-
<b>Departmental Programs</b>		
1. Quality seed for sustainable aquaculture	AQD	14.1
2. Healthy and wholesome aquaculture	AQD	14.1
3. Maintaining environmental integrity through responsible aquaculture	AQD	14.1
4. Adapting to climate change impacts	AQD	14.3
5. Meeting social and economic challenges in aquaculture	AQD	14.b
6. Promotion on Strengthening of SEAFDEC Visibility and Image	TD	-
7. Tailor-made Training Programs	TD	-
8. Improvement of Fisheries Technology and Reduction of the Impact from Fishing	TD	14.3
<b>Other Programs</b>		
1. Coastal Area Capability Enhancements in Southeast Asia (SEAFDEC/RIHN Collaborative Project)	TD	14.2
2. Application of Fish Passage Design Principles to Enhance Sustainability of Inland Fishery Resources in the Southeast Asian Region (ACIAR supported Project)	TD	-
3. Enhancing Sustainable Utilization and Management Scheme of Tropical Anguillid Eel Resources in Southeast Asia	TD	-

**Note:**

The SEAFDEC Program Framework adopted by the SEAFDEC Council in 2009, comprises five Program Thrusts (Thrust I: Developing and Promoting Responsible Fisheries for Poverty Alleviation & Food Security; Thrust II: Enhancing Capacity & Competitiveness to Facilitate International and Intra-regional Trade; Thrust III: Improving Management Concepts and Approaches for Sustainable Fisheries; Thrust IV: Providing Policy & Advisory Services for Planning & Executing Management of Fisheries; Thrust V: Addressing International Fisheries Related Issues from a Regional Perspective)

#### Box 4. SEAFDEC Program Thrusts and the SDGs

SEAFDEC Program Thrusts	SDGs
Developing and Promoting Responsible Fisheries for Poverty Alleviation & Food Security	1, 2, 8, 12, 14
Enhancing Capacity & Competitiveness to Facilitate International and Intra-regional Trade	12, 14
Improving Management Concepts and Approaches for Sustainable Fisheries	1, 2, 8, 12, 14
Providing Policy & Advisory Services for Planning & Executing Management of Fisheries	12, 14
Addressing International Fisheries Related Issues from a Regional Perspective	12, 14
Special Projects	5, 13

of new technologies, research and information dissemination activities” is also proposed to be modified in order to align it with the proposed new SEAFDEC Vision and Strategies.

Moreover, in order to achieve the alignment of SEAFDEC activities with the SDG 14 and enhance its contribution to SDG 14, a “*results tracking framework*” could be developed as it would facilitate reporting of the activities of SEAFDEC and Member Countries that are aligned with the SDGs, and could be reflected in relevant international fora (SEAFDEC, 2017). Furthermore, during the Ocean Conference on 5-9 June 2017 in New York, SEAFDEC together with relevant organizations will take active part in the Side Event on “Coral Triangle – Partnerships to Achieve SDG 14 in the World’s Epicenter of Marine Biodiversity,” where the efforts of SEAFDEC in this aspect would be reflected and promoted to the world audience.

## References

- Kongpathai Saraphaivanich, Yanida Suthipol, Namfon Imsamram, Bundit Chokesanguan, and Somboon Siriraksophon. 2016. Regional Fishing Vessels Record: A Management Tool for Combating IUU Fishing in Southeast Asia. *In: Fish for the People*, Vol. 14 No. 2: 2016, Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 12-17
- Hjh. Mahyam bte Mohd. Isa, Syed Abdullah bin Syed Abdul Kadir and Wahidah bte Mohd. Arshaad. 2008. Following-up on the Conservation of Sea Turtles in Southeast Asia: DNA Study. *In: Fish for the People*, Vol. 6 No. 2: 2008, Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 6-11
- Paterson, Christopher. 2017. Support the Implementation of Sustainable Development Goal 14: Conserve and Sustainably Use the Oceans, Seas and Marine Resources for Sustainable Development (representing the SEAFDEC-UNEP/GEF Project implemented by SEAFDEC/TD) in Report of the Forty-ninth Meeting of the Council of the Southeast Asian Fisheries Development Center, Brunei Darussalam, 3-7 April 2017; in press
- SEAFDEC. 2000. Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Fishing Operations. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 71 p
- SEAFDEC. 2001. ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 7 p
- SEAFDEC. 2003. Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Fisheries Management. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 69 p





- SEAFDEC. 2005a. Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Aquaculture. 2<sup>nd</sup> Ed. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 43 p
- SEAFDEC. 2005b. Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Post-Harvest Practices and Trade. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 58 p
- SEAFDEC. 2006. Regional Guidelines for Responsible Fisheries in Southeast Asia: Supplementary Guidelines on Co-management Using Group User Rights, Fishery Statistics, Indicators, and Fisheries *Refugia*. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 84 p
- SEAFDEC. 2010. Regional Guidelines for the Promotion of “One Village, One Fisheries Product” (FOVOP) in the ASEAN Region. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 31 p
- SEAFDEC. 2011. ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 23 p
- SEAFDEC. 2015. Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 14 p
- SEAFDEC. 2016. ASEAN-SEAFDEC Joint Declaration on Combating IUU Fishing and Enhancing the Competitiveness of ASEAN Fish and Fishery Products. Report of the High-Level Consultation on Regional Cooperation on Sustainable Fisheries Towards the ASEAN Economic Community: Combating IUU Fishing and Enhancing the Competitiveness of ASEAN Fish and Fishery Products, Bangkok, Thailand, August 2016. Southeast Asian Fisheries Development Center, Bangkok, Thailand
- SEAFDEC. 2017. Report of the Forty-ninth Meeting of the Council of the Southeast Asian Fisheries Development Center, Brunei Darussalam, 3-7 April 2017; in press
- SEAFDEC/MFRDMD. 2015. ASEAN Guidelines for Preventing the Entry of Products from IUU Fishing into the Supply Chain. SEAFDEC Marine Fishery Resources Development and Management Department, Kuala Terengganu, Malaysia; 22 p
- SEAFDEC/TD. 2016. Report of the Experts Meeting on Regional Cooperation to Support the Implementation of Port State Measures in Southeast Asian Region. SEAFDEC Training Department, Thailand; 78 p
- Somboon Siriraksophon, Hajime Kawamura and Namfon Imsamrarn. 2016. Securing the Nice of ASEAN Fish and Fishery Products in the Global Market: ASEAN Catch Documentation Scheme for Marine Capture Fisheries. *In: Fish for the People*, Vol. 14 No. 2: 2016, Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 24-33
- Taweekiet Amornpiyakrit and Somboon Siriraksophon. 2016. Management of Fishing Capacity for Sustainable Fisheries: RPOA-Capacity. *In: Fish for the People*, Vol. 14 No. 2: 2016, Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 18-23

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# Improving Fisheries Management in Southeast Asia in Support of the Sustainable Development Goals

Magnus Torell

Since the *United Nations Conference on the Human Environment* in Stockholm, Sweden on 5-16 June 1972, voices are increasingly raised on the need for concerted efforts to be put in place and implemented to ensure sustainable development by *balancing availability of resources with the level of harvesting*, and in the process *ensuring that methods used are not damaging to nature* - and that the *benefits are shared equitably to reduce poverty and improve human well-being*. The global dialogue initiated in Stockholm has continued since then and the ambitions and commitments of governments and independent actors had been defined and as needed reinforced, during major events like the *UN Conference on Environment and Development* (UNCED) in Rio de Janeiro, Brazil in 1992. That Conference succeeded in building consensus on actions needed and specifically, guidance was stipulated in its “*Agenda 21*” that provides directions with regards to marine and coastal resources. Ten years after UNCED in Rio another milestone event, the *World Summit on Sustainable Development* (WSSD) was organized in Johannesburg, South Africa in 2002. In addition to state leaders, participants included private sector, NGO and CSO representations. A short-coming though was the limited representation from the US Government. If the meeting in Johannesburg, due to lack of commitment from countries like the USA, had its limitations, further advances was made another ten years later when the *United Nations Conference on Sustainable Development* (Rio+20) was held for the second time in Rio de Janeiro in June 2012. The Rio+20 Conference was instrumental in initiating the process of developing what would become the *Sustainable Development Goals (SDGs)*. After a consultative process over three years, the SDGs were finally adopted on 25 September 2015 by the 193 UN Member States at the UN General Assembly in New York. On that occasion, then UN Secretary-General Ban Ki-moon stated that: “*The new agenda is a promise by leaders to all people, everywhere. It is a universal, integrated and transformative vision for a better world*”.

## The Sustainable Development Goals

The 17 Sustainable Development Goals (SDGs) and 169 supporting targets (United Nations, 2015) are both multi-focused and multi-dimensional covering the major aspects to be addressed in reaching the targets of sustainability – ranging from poverty alleviation and food security, “life below water” and “life on land” including freshwater systems and climate action, to decent work, gender equality, peace, justice and partnerships for achieving the goals. The SDGs are documented in Paragraph 54 of the United Nations Resolution A/RES/70/1 of 25 September 2015 (United Nations, 2015).

The goals and targets are in many ways reflections of many parallel processes that since the Stockholm Conference and earlier fora, are working on developing globally recognized agreements and conventions covering a very broad range of sectors and social dimensions. With special focus on marine and coastal concerns, the *1982 UN Convention on the Law of the Sea (UNCLOS)* at its adoption provides broad and far-reaching binding framework for responsibilities and obligations with regards to marine and coastal areas within and outside of the economic zones of coastal states – and “life below water” which is SDG 14.



Adapted from United Nations (2015)

Far-reaching global targets in support of collective efforts to secure long-term sustainability in fisheries and aquatic resources management is also provided through the Aichi Targets that recognized the vital importance to maintain and conserve the aquatic resources through well-managed fisheries (CBD, 2010). The *Aichi Targets* were developed through a consultative process and adopted by the parties to the Convention of Biodiversity (CBD) during the 10<sup>th</sup> Conference of the Parties to the CBD held in Nagoya, Japan in 2010. At the CBD Conference, the parties to the CBD Convention supported a new Strategic Plan for Biodiversity 2011-2020. The Plan consists of 20 targets that are called the *Aichi Targets* and specifically, Target Number 6 provides a very ambitious target with regards to the management of fisheries.

The list of relevant and important international agreements with regards to fisheries is very long but the development and adoption of the *FAO Code of Conduct for Responsible Fisheries (1995)* are of special significance and have provided guidance throughout the world on efforts to ensure socially and environmentally sustainable fisheries. The significance of the Code of Conduct for Responsible Fisheries (CCRF) was also recognized by SEAFDEC and the ASEAN Member States

(AMSs). A consultative process was initiated by SEAFDEC to look at the CCRF in an ASEAN perspective that culminated with the *ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium “Fish for the People,”* in 2001 in Bangkok, Thailand and the subsequent adoption of the *Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region* (SEAFDEC, 2001) that has served as framework for the Southeast Asian countries in formulating programs and activities on sustainable fisheries for food security. This was followed by the development of a set of Regional Guidelines for Responsible Fisheries from 2003 and onwards, where the volume on “Responsible Fisheries Management” was more of an explanation of the CCRF in a Southeast Asian context rather than “guidelines” as such (SEAFDEC, 2003).

Ten years after the 2001 Conference, the ASEAN-SEAFDEC member countries felt it was time to revisit the Resolution and Plan of Action in order to confirm and/or redefine priorities and commitments. In response to the request from countries and regional collaborating agencies, the *ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020: “Fish for the People 2020: Adaptation to a Changing Environment”* was convened by SEAFDEC in June 2011 in Bangkok, Thailand (SEAFDEC, 2011a). In conjunction with the Conference, the ASEAN-SEAFDEC Ministers and Senior Officials adopted the *“Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region towards 2020”* (SEAFDEC, 2011b). Therefore, the ambitions among the AMSs to strengthen regional unity through the ASEAN Community building is, as expressed in the ASEAN Socio-Cultural Community Blueprint and the ASEAN Economic Community Blueprint, in conformity with the SDGs and supportive of achieving the expressed targets.

## Moves in the ASEAN Region in Support of the SDGs and Targets

As shown in the introduction and references above, many agreements and actions being implemented in the ASEAN region are, without explicitly stating it, supporting to global ambitions to achieve the SDGs and to reach the Aichi Targets. However, this paper only points at selected SDGs and SDG targets that are of relevance to the regional efforts of managing

fisheries sustainably with due consideration being given to social (gender) aspect, poverty alleviation and food security.

### Sustainable Development Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture



**SDG 2, Target 3:** *By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment*

The targets set out in **Goal 2** are also basic to the ambitions of the ASEAN Community building as expressed in the ASEAN Socio-Cultural Community Blueprint and the ASEAN Charter. In the “ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020” (ASEAN-SEAFDEC Resolution 2020), sustainable fisheries as a necessity to ensure food security is the very essence of the Resolution and subsequent implementation of activities in the region should have this perspective (SEAFDEC, 2011b).

### Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources

**Goal 14** is the main goal in terms of calling upon states and individuals to responsibly manage and use available marine resources and to combat illegal and destructive fishing practices. The aim to work together for the sustainability of fisheries is central to the ASEAN-SEAFDEC Resolution 2020 and the need to combat illegal fishing practices was highlighted during an ASEAN-SEAFDEC High-level Consultation in Bangkok 2016 (SEAFDEC, 2016a).



**SDG 14, Target 2:** *By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans*

**SDG 14, Target 4:** *By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated (IUU) fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics*



Efforts to strengthen cooperation, as well as manage and protect marine and coastal ecosystems in the ASEAN region and in target sub-regions, e.g. Gulf of Thailand, Andaman Sea and the Sulu-Sulawesi Seas, are the essence in many programs and projects being implemented in the Southeast Asian region over the last decades. These include the UNEP/GEF South China Sea Project, SEAFDEC-Sweden Project, FAO-Bay of Bengal Large Marine Ecosystem (BOBLME) Project, and the Coral Triangle Initiative – for Corals, Fisheries and Food Security (CTI-CFF).

Specifically, finding solutions and mobilizing joint action to combat illegal fishing and to strengthen regulatory measures while improving recording systems of catches and landings that allows for traceability, such as through the ASEAN Catch Documentation Scheme, is top of the Agenda in the ASEAN region. This is under-pinned by struggles of exporting countries to maintain global market access and to remove the threats of “yellow” and “red” cards. SEAFDEC is leading several regional and sub-regional initiatives that aim to combat illegal fishing and improve regulatory measures in cooperation with the ASEAN, FAO, Regional Plan of Action to Promote Responsible Fishing Practices including Combating IUU Fishing in the Region (RPOA-IUU), CTI-CFF, US, Australia and Sweden, among others.



**SDG 14, Target 5:** *By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information*

**SDG 14, Target 7:** *By 2030, increase the economic benefits to Small Island Developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism*

Over the last couple of decades the capacity among the AMSs to conserve and designate special areas for conservation and rehabilitation, has increased significantly with the establishment of special government agencies (e.g. Ministries of Natural Resources and Environment) that in cooperation with other stakeholders, monitor the status of marine and coastal areas. At the regional and sub-regional levels, significant contributions have been made through projects like the UNEP/GEF Project on “Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand.”

With an added fisheries focus to the integration of fisheries and habitat management, the SEAFDEC-Sweden Project has, together with participating countries, supported the facilitation of regional and bilateral cooperation in the Gulf of Thailand and the Andaman Sea. In the Andaman Sea, valuable contributions have also been made by the FAO-BOBLME Project.

Although **Target 7** addresses the special needs of Small Island Developing States and their special need, a similar approach is being undertaken by SEAFDEC and collaborating agencies with regards to the lesser developed countries of the ASEAN (i.e. Cambodia, Myanmar and Lao PDR – and Timor-Leste) by providing extra attention in terms of capacity-building and in strengthening the ability to sustainably use marine and freshwater resources.



**SDG 14, Target 9:** *Provide access for small-scale artisanal fishers to marine resources and markets*

**SDG 14, Target 10:** *Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of ‘The Future We Want’*

To strengthen the capacity and resilience of smaller-scale fishing communities, including access to resources and markets, is the key objective of a multitude of projects being implemented in each of the ASEAN-SEAFDEC member country. Strengthening the rights and opportunities for smaller-scale fisher-folk and other communities, is also emphasized in the ASEAN Socio-Cultural Community Blueprint.

At the regional level and upon adoption in 2014 of the FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines), finding suitable approaches to support the implementation of the SSF Guidelines were called for (FAO, 2015). Thus, a number of important events calling upon government agencies, NGOs, Civil Society Organizations (CSOs), had been held notably in Bali, Indonesia in 2015 and in Bangkok, Thailand in 2016. Although the main support to small-scale fisheries is to be made at national level, a broader context of the importance of small-scale fisheries will continue to be addressed at the regional and sub-regional levels (SEAFDEC, 2016b).

Moreover, SEAFDEC in cooperation with agencies such as FAO, RPOA-IUU, International Labour Organization (ILO), United Nations Environmental Programme (UNEP) and others is regularly reviewing the international instruments and conventions with a view to assess and provide information to the ASEAN-SEAFDEC Member Countries on their implications to the fisheries sector in the region and to people dependent on the fishery resources. To allow for the uptake of relevant parts of international agreements, regional expert meetings and consultations have been organized by SEAFDEC where reference is made to the CCRF, FAO Port State Measures Agreement (PSMA), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES),

International Maritime Organization (IMO) Conventions, ILO Conventions, SFF Guidelines, UN Convention on the Law of the Sea (UNCLOS), International Plan of Action for the Management of Fishing Capacity (IPOA-Capacity), and so on.

Furthermore, responses to SDG 14 are being reinforced by global and regional efforts made to reach **Aichi Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use (Box 1)**.

**Box 1. Aichi Target Number 6**

“By 2020, all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

**Sustainable Development Goal 6: Ensure access to water and sanitation for all**

In terms of inland fisheries, the SDGs are less direct than in the case of “life below water” (SDG14). However, SDG 6 and SDG 15 (“life on land”) provide some directives and targets to aim for. In the Southeast Asian region, inland fisheries are of vital importance to millions of people, and the Mekong and Irrawaddy Rivers are among the most productive freshwater systems of the world.



**SDG 6, Target 5:** *By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate*

**SDG 6, Target 6:** *By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes*

**SDG 6, Target 8:** *Support and strengthen the participation of local communities in improving water and sanitation management*

The Southeast Asian region features many transboundary waterbodies with the most important being the Mekong River. Cooperation among riparian states has been promoted over the last fifty years and since 1995 through the **Mekong River Commission (MRC)** based on the **1995 Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin**.

Through the MRC, integrated water resources management is promoted and since over twenty years, and the MRC Fisheries Programme has been estimating that the fish catches from the Mekong River could easily add up to 3 to 4 million metric tons annually. MRC, SEAFDEC, WorldFish Center, International

Union for Conservation of Nature (IUCN), World Wide Fund for Nature (WWF) and others are actively engaged in supporting the sustainability of fisheries in the Mekong River and other inland water bodies, including through the newly established SEAFDEC Inland Fishery Resources Development and Management Department (SEAFDEC/IFRDMD). Trans-boundary cooperation on fisheries and habitat management are also being promoted in border areas between Cambodia and Lao PDR, Cambodia and Thailand, and Cambodia and Viet Nam.

Much of the work referred to above in support of **Target 5**, are to a large degree incorporating the efforts to maintain and restore important ecosystems and habitats as well as to ensure that inter-connectivity is maintained to allow fish to migrate to and from spawning areas. The monsoon-based seasonal variations with distinct wet and dry seasons require protection of the dry season refuge areas (where fish can reside during the dry season). In response to this concern, major efforts are undertaken to define and manage the Mekong deep pools and flood plain dry season ponds as well as other refuge areas. These activities are promoted by MRC, SEAFDEC, WorldFish Center, IUCN, WWF as well as national agencies.

At national levels, several national agencies, local CSOs and local NGOs are together with the MRC, SEAFDEC, WorldFish Center, IUCN and WWF, contributing to strengthening of the capacity of local communities while at the same time enhancing their participation in planning, decision-making and implementation of fisheries and supportive livelihood activities. In countries like Cambodia, Lao PDR and Thailand, special laws and sub-decrees are developed that create opportunities for inland and coastal communities to establish community fisheries. SEAFDEC, FAO, and partner organizations, together with countries and CSOs in the region, are exploring the options to support the SSF Guidelines.

**Sustainable Development Goal 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss**

Much of what was mentioned with reference to SDG 6 is also relevant to actions taken in the region with regards to SDG 15 and related targets.



**SDG 15, Target 1:** *By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements*

**SDG 15, Target 5:** *Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species*

**SDG 15, Target 8:** *By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species*

In measures taken and activities implemented for the sustainable use of inland fishery resources, it is recognized that the health and connectivity of freshwater ecosystems need to be maintained. The importance of the freshwater ecosystems has been highlighted by the MRC Fisheries and Environment Programme, WorldFish Center, IUCN, WWF and others. SEAFDEC has also provided capacity-building on ecosystems approach to fisheries management for Lao PDR and (inland) Cambodia. Many national initiatives throughout the region including the establishment of protected areas, are contributing to the conservation of freshwater ecosystems in ways that also benefit the conservation of fish and aquatic resources.

Major measures are taken to reduce degradation of natural habitats and to halt the loss of biodiversity. With regards to inland fisheries this is linked to the need to preserve the health and connectivity of freshwater ecosystems and to protect dry season refuge areas. Special efforts are being made to prevent the extinction of threatened species such as the Mekong giant catfish (*Pangasianodon gigas*) and Mekong-Irrawaddy River dolphin (*Orcaella brevirostris*), among others. The potential threats being posed to aquatic ecosystems by the impacts of invasive alien species is now well recognized throughout the Southeast Asian region.

Regional Guidelines have been developed and are implemented. Good Aquaculture Practice programs and recommendations on stock enhancement include strict restriction against introduction of alien species. Almost all countries in the region have rules and regulation with restrictions on the introduction of alien species.

Responses to SDG 6 and 15 are being reinforced by global and regional efforts made to reach **Aichi Strategic Goal D: Enhance the benefits to all from biodiversity and Ecosystems Services (Box 2).**

**Box 2. Aichi Target Number 14**

By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

**Sustainable Development Goal 5: Achieve gender equality and empower all women and girls**



**SDG 5, Target 7:** *Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial*

*services, inheritance and natural resources, in accordance with national laws*

The importance to build upon and promote gender equality by giving all members of the society equal rights and – as far as possible – equal opportunities is increasingly recognized in the Southeast Asian region. Many of the ASEAN countries, such as the Philippines and ASEAN as a whole, have gender strategies and policies in place. With specific reference to fisheries and the designated fisheries agencies, there already exist gender strategies, such as in the case of Cambodia. At the regional level, the ASEAN as earlier mentioned had spearheaded gender integration, and with regards to inland fisheries the Fisheries Programme of MRC had established a fisheries gender network some ten years ago. Other organizations including SEAFDEC, is increasingly mainstreaming gender issues in their programs and projects. In fact, SEAFDEC had already designated its gender focal point in 2015. Coordination is encouraged, and IUCN/WWF, SEAFDEC and the Stockholm Environment Institute (SEI) Asia, among others, are in the process of undergoing comprehensive reviews of gender in fisheries and habitat management, as well as gender roles and functions in coastal communities. In addition SEAFDEC, through the SEAFDEC-Sweden Project, is promoting that all contracts for local capacity-building and community development should have gender aspects clearly integrated.

**Sustainable Development Goal 8: Promote inclusive and sustainable economic growth, employment and decent work for all**

The efforts to seek reliable employment and decent work for all, have over the past decade been gaining increased attention also within the fisheries sector. During the Forty-eighth Meeting of the SEAFDEC Council in April 2016, the Council encouraged SEAFDEC to give more attention to labor issues and working conditions within the fishing industry. Some AMSs, such as Thailand, are on their way to accede to the ILO Convention 188 on Work in Fishing (SEAFDEC, 2016c).



**SDG 8, Target 5:** *Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms*

**SDG 8, Target 6:** *Protect labor rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment*

**Target 5 and Target 6** are interlinked and frameworks to develop good labor practices (GLP) addresses both on the need for safe and secure working environments as well as

eradicating forced labor, human trafficking and child labor. In response to the request from the SEAFDEC Council and Member Countries, SEAFDEC organized the First Regional Technical Consultation on Labor Aspects within the Fishing Industry in the ASEAN Region in 2016 (SEAFDEC, 2016c).

The Consultation highlighted on the importance of ASEAN Declarations on labor and working conditions, including the ASEAN Declaration on the Protection and Promotion of the Rights of Migrant Workers, the ASEAN-SEAFDEC Resolution 2020 and the *Joint ASEAN-SEAFDEC Declaration on Regional Cooperation for Combating Illegal, Unreported and Unregulated Fishing and Enhancing the Competitiveness of ASEAN Fish and Fishery Products*. The collective regional efforts to secure decent work is becoming cross-cutting and reference to labor, crew and migrant workers are being addressed in connection with the Regional Plan of Action on Sustainable Utilization of Neritic Tunas in the ASEAN Region (RPOA-Neritic Tunas), RPOA for Managing Fishing Capacity (RPOA-Fishing Capacity), efforts to combat illegal fishing, port inspections/port state measures, and on aspects related to safety at sea. SEAFDEC will continue to work with and strengthen cooperation with ILO, FAO, ASEAN and others to further, as suitable, develop the ASEAN Guidelines on Implementation of Labor Standards for the Fisheries Sector.

## SEAFDEC Actions in Support of SDGs and Aichi Strategic Goals

The abovementioned brief overview indicates that there are many activities and efforts ongoing with regards to addressing the Sustainable Development Goals, thereby supporting efforts to reach the most appropriate but selected targets – although not referring to the SDGs as a whole. In the effort of SEAFDEC to promote ecosystem-based approach to fisheries management (EAFM), **Fig. 1** shows how the promoted actions support ecological well-being, human well-being, and good governance, and for the longer term, social and environmental sustainability of the Southeast Asian region. SEAFDEC would remain committed to work with the AMSs and its collaborating agencies in attaining the relevant targets of the SDGs, through the promotion of sustainable fisheries management in the region.



**Fig. 1.** Schema of the ecosystem-based approach to fisheries management being promoted by SEAFDEC in the Southeast Asian region

## References

CBD. 2010. Aichi Biodiversity Targets. Report of the Tenth Meeting of the Conference of Parties to the Conservation on Biological Diversity, Nagoya, Aichi Prefecture, Japan, 18-29 October 2010; 339 p

FAO. 2015. FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication. FAO, Rome, Italy

SEAFDEC. 2001. Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 7 p

SEAFDEC. 2003. Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Fisheries Management. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 69 p

SEAFDEC. 2011a. Proceedings of the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security Towards 2020: Adaptation to a Changing Environment, Bangkok, Thailand, 13-17 June 2011; Volume I: The Conference Proceedings. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 258 p

SEAFDEC. 2011b. ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 23 p

SEAFDEC. 2016a. ASEAN-SEAFDEC Joint Declaration on Combating IUU Fishing and Enhancing the Competitiveness of ASEAN Fish and Fishery Products. Report of the High-Level Consultation on Regional Cooperation on Sustainable Fisheries Towards the ASEAN Economic Community: Combating IUU Fishing and Enhancing the Competitiveness of ASEAN Fish and Fishery Products, Bangkok, Thailand, August 2016. Southeast Asian Fisheries Development Center, Bangkok, Thailand

SEAFDEC. 2016b. Regional Approaches for Securing Sustainable Small-Scale Fisheries. Report of the Regional Technical Consultation on a Regional Approach to the Implementation of the FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries for Food Security and Poverty Eradication, June 2016, Bangkok, Thailand. Southeast Asian Fisheries Development Center, Bangkok, Thailand

SEAFDEC. 2016c. Proposed ASEAN Guidelines for the Implementation of Labor Standards for the Fisheries Sector. Report of the First regional Technical Consultation on Labor Aspects within the Fishing Industry in the ASEAN Region, Bangkok, Thailand, 25-27 February 2016. Southeast Asian Fisheries Development Center, Bangkok, Thailand

United Nations. 2015. United Nations Resolution A/RES/70/1 of 25 September 2015 - Transforming our world: the 2030 Agenda for Sustainable Development. UN Sustainable Development Summit, 25-27 September 2015, New York, U.S.A.S., 35 p

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## The South China Sea Fisheries *Refugia* Initiative and the Sustainable Development Goals

*Christopher J. Paterson and Weerasak Yingyuad*

The Sustainable Development Goals (SDGs), officially known as “Transforming our World: the 2030 Agenda for Sustainable Development” are a set of seventeen aspirational “Global Goals” with 169 targets between them. Spearheaded by the United Nations through a deliberative process involving its 194 Member States as well as global civil society, the Goals are contained in Paragraph 54 of the United Nations Resolution A/RES/70/1 of 25 September 2015. The SDGs and associated targets are integrated and indivisible, global in nature and universally applicable, taking into account different national realities, capacities and levels of development and respecting national policies and priorities. Targets are defined as aspirational and global, with each Government setting its own national targets guided by the global level of ambition but taking into account national circumstances. It is anticipated that each Government will also decide on how these aspirational and global targets should be incorporated into national planning processes, policies and strategies.

### Sustainable Development Goals and the Promotion of Sustainable Fisheries in Southeast Asia

The Sustainable Development Goals (SDGs) acknowledge that oceans, seas and marine resources are essential to human well-being and social and economic development worldwide. Their conservation and sustainable use are central to achieving the 2030 Agenda. Marine resources are particularly important for people living in coastal communities, who represented 37 per cent of the world’s population in 2010. Oceans provide livelihoods, subsistence and benefits from fisheries, tourism and other sectors. They also help regulate the global ecosystem by absorbing heat and carbon dioxide (CO<sub>2</sub>) from the atmosphere. However, the formulation of the 2030 Agenda for Sustainable Development implicitly acknowledged that oceans and coastal areas are extremely vulnerable to environmental degradation, overfishing, climate change and pollution. Accordingly, **Sustainable Development Goal 14** which advocates to ‘conserve and sustainably use the oceans, seas and marine resources for sustainable development’ or

otherwise known as the ‘**Life Below Water**’ goal, was adopted with a set of 10 key result areas comprising seven primary and three supplementary targets (United Nations, 2015).

Regarding the promotion of sustainable fisheries, **Sustainable Development Goal 14** has very specific targets relating to inter alia: the effective regulation of harvesting and ending overfishing; management of illegal, unreported and unregulated fishing and destructive fishing practices; implementation of science-based management plans in order to restore fish stocks in the shortest time feasible; conservation of at least 10 percent of coastal and marine areas; and the prohibition of certain forms of fisheries subsidies which contribute to overcapacity and overfishing including the elimination of subsidies that contribute to illegal, unreported and unregulated (IUU) fishing; improving access for small-scale artisanal fishers to marine resources and markets; and enhancing the conservation and sustainable use of oceans and their resources by implementing international laws as reflected in the 1982 United Nations Convention on the Law of the Sea (UNCLOS). Given the vulnerability of many coastal communities globally to the continued degradation of coastal and marine environments and resources, the global community called for and agreed the timeline for achieving the targets relating to fisheries and the conservation of coastal and marine areas which is by 2020. Such call was aimed at driving accelerated efforts to bring about the transformational change required to fashion more sustainable futures for the world’s fisheries.

While the abovementioned goal and its targets are of high level significance to the work of SEAFDEC and its Member Countries in the promotion of sustainable fisheries, a number of additional SDGs cut across the work of promoting sustainable fisheries in the Southeast Asian context. These are the goals that relate to: No Poverty (**SDG 1**); Zero Hunger (**SDG 2**); Gender Equality (**SDG 5**); Decent Work and Economic Growth (**SDG 8**); Responsible Consumption and Production (**SDG 12**); and Climate Action (**SDG 13**). This paper presents the anticipated contributions of the Global Environment Facility (GEF)-financed, United Nations Environment Programme (UNEP)-implemented, and SEAFDEC-executed project on ‘*Establishment and Operation of a Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand*’ (hereinafter referred to as the ‘South China Sea Fisheries Refugia Initiative’) to the Sustainable Development Goals.

## South China Sea: A Globally Significant Large Marine Ecosystem

The South China Sea that includes the Gulf of Thailand is a strategic body of water surrounded by nations that are currently at the helm of industrialization and rapid economic growth in the Asia-Pacific region. Bordered by the People’s Republic of China to the north, Republic of the Philippines



The South China Sea

to the east; Malaysia, Republic of Singapore, Republic of Indonesia and the Sultanate of Brunei Darussalam to the south, and the Kingdoms of Thailand and Cambodia, and the Socialist Republic of Viet Nam to the west, the South China Sea has always been central to issues of economic and political stability in Southeast Asia and adjacent regions. Today, it is central to defining environmental sustainability and food security for its coastal nations. The coastal sub-regions of these nations are home to approximately 270,000,000 people or 5 percent of the world’s total population.

The International Hydrographic Organization (IHO) defined South China Sea as a semi-enclosed body of water stretching in a southwest to northeast direction, whose southern border is three degrees south latitude between South Sumatra and Kalimantan (Karimata Straits), and whose northern border is the Strait of Taiwan from the northern tip of Taiwan to the Fukien Coast of China (IHO, 1953). About 122 major rivers drain 2.5x106 km<sup>2</sup> of catchments and deliver materials, including suspended sediments, nutrients and pollutants, to the South China Sea and Gulf of Thailand. Socio-economically, culturally and aesthetically, the South China Sea, the Gulf of Thailand and regional river basins and bays form part of the common heritage of the people of the Southeast Asian region. The region’s expanding population relies on the South China Sea and Gulf of Thailand for nutrition, livelihoods, recreation and economic pursuits (e.g. tourism), energy (e.g. oil and gas), aquaculture, pharmaceuticals, the ornamental fish trade, construction materials, and ports and shipping. However, recent findings of the Global Environment Facility’s Transboundary Waters Assessment Programme identified that coastal communities bordering the South China Sea and

Gulf of Thailand are among the most at risk globally from continued coastal and marine environmental degradation (IOC-UNESCO and UNEP, 2016).

### A Global Center of Tropical Marine Biodiversity

The Indo-West Pacific marine biogeographic province has long been recognized as the global center of marine tropical biodiversity. Forty-five mangrove species out of a global total of 51 (Spalding *et al.*, 2010); 50 of 70 coral genera (Tomascik *et al.*, 1997); 20 of 50 sea grass species (Sudara *et al.*, 1994); and 7 of 9 giant clam species (Tomascik *et al.*, 1997) are found in the nearshore areas of the South China Sea. Like most tropical coastlines worldwide, the dominant coastal ecosystems of the South China Sea and Gulf of Thailand marine basin are mangroves, coral reefs and sea grass meadows. Significant other coastal ecosystems include coastal lagoons, a common coastal landform in Viet Nam, and extensive inter-tidal unvegetated mudflats that are found in many places around the South China Sea (UNEP, 2008).



(Source: Google)

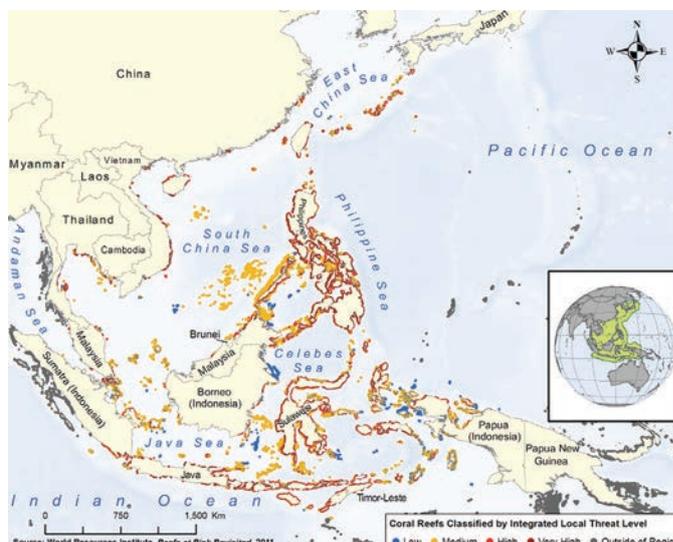
The South China Sea is considered to be one of two global hotspots of mangrove diversity (Polidoro *et al.*, 2010; Vo *et al.*, 2013). According to data generated through the South China Sea project, the largest total area of mangrove on the South China Sea coast is observed in Indonesia (934,000 ha), followed by Malaysia (532,000 ha) and Viet Nam (157,000 ha). The combined area of mangrove observed on the South China Sea coastlines of Cambodia, China, Philippines and Thailand is less than 150,000 ha. The total area of mangrove on the South China Sea coast of all countries combined is estimated to be 1,770,000 ha (UNEP, 2008), representing 11.4% of the world's remaining 15.5 million ha of mangrove forest (Vo *et al.*, 2013).

Southeast Asia is also recognised as the global center of coral reefs, both in terms of areal extent and species diversity. An estimated 1/3 of the Earth's coral reefs (91,700 km<sup>2</sup> of 284,000 km<sup>2</sup>) are located in the seas of Southeast Asia (Burke *et al.*, 2002). Fringing reefs are well developed away from the major river estuaries, particularly in the Philippines and the central and southern areas of the South China Sea. All major reef types from fringing, patch or platform reefs and atolls occur in the South China Sea. Based on data compiled by members

of the Regional Working Group on Coral Reefs (RWG-CR) (UNEP, 2007), approximately 750,000 ha of coral reef has been identified in the South China Sea coastal waters of the following six countries: Cambodia (2807 ha), Indonesia (39,300 ha), Malaysia (43,400 ha), Philippines (464,000 ha), Thailand (90,000 ha), and Viet Nam (110,000 ha).

In terms of species richness, the southern and eastern coastlines of the South China Sea fall within the so-called coral triangle and within the isopangeneric contour of 70 coral genera (Veron, 1995). Comparative analysis of the distribution of maximum marine biodiversity for various taxonomic groups has been reviewed by Hoeksema (2007) who noted that different authors have defined different 'triangles' and applied different names to this 'center' of marine biodiversity. Some of these triangles only include the eastern side of the South China Sea, while others encompass the southern half of the South China Sea.

As a consequence of more recent surveys in Viet Nam (Vo *et al.*, 2013), it has been recommended that this contour be expanded westwards to cover the south-central waters of Viet Nam thus corresponding more closely to the coral triangle delimited by Briggs (2005a, b). The recent finding of the hard coral *Leptoseris kalayaanensis* in Nha Trang (westernmost location in the South China Sea), the Northeast Investigator Shoal (Kalayaan Islands) and North Danger Reefs complex indicate that little is known about the coral fauna of the South China Sea relevant to the positioning of the northwestern boundary of the center of maximum coral species richness, the 'so-called' Coral Triangle (Hoeksema *et al.*, 2010). In terms of diversity at individual localities, hotspots of coral species richness occur at Nha Trang (Viet Nam) with 351 species (Vo *et al.*, 2002), El Nido (Palawan, Philippines) with 305 species (UNEP, 2007), and Bolinao (Philippines) with 322 species (Licuanan, 2009). Records of more than 200 species occur at a number of sites in Viet Nam, Indonesia and Philippines



(Source: Adapted from World Resources Institute)

Reefs at Risk in Southeast Asia

(UNEP, 2007), and Malaysia. Verde Island passage (between the islands of Mindoro and Luzon in the Philippines), for example, is considered a globally significant hotspot of coral reef associated species.

The largest areas of sea grass meadows identified in the South China Sea to date are in the coastal waters of Kampot Province in Cambodia (25,200 ha), Cape Bolinao in the Philippines (22,400 ha), Phu Quoc and neighbouring islands in Viet Nam (12,500 ha), and East Bintan in Indonesia (2,000 ha) (UNEP, 2008; Vo, 2010). The transboundary water area between Cambodia and Viet Nam, including the large connected sea grass meadows of Kampot and Phu Quoc, contain possibly the largest sea grass bed in the South China Sea (37,000 ha) and play a globally significant role as critical fisheries *refugia* for fish stocks of significance to regional food security (Paterson *et al.*, 2013). The record of 10 species of sea grasses and a dugong population (Tu Thi Lan Huong *et al.*, 2002) at this locality also indicates the importance of these transboundary waters to regional biodiversity conservation.

### Supporting Globally Significant Fisheries and Aquaculture Production

The South China Sea also supports a significant world fishery that is important to the food security of, and as a source of export income for, Southeast Asian countries. Landings from this area contribute approximately 10 percent of reported global fisheries production per annum and make significant contributions to the economies of countries bordering the Gulf of Thailand and the South China Sea. This is significant considering that marine capture fisheries production of Southeast Asia, including landings from both Indian and Pacific Oceans, ranges between 14 and 16 million metric tons per annum, representing more than 19 percent of marine capture fisheries production worldwide (Table 1).

Moreover, Indonesia, Viet Nam, Myanmar, Philippines, and Thailand are the top five producing countries of marine capture fishery products (Fig. 1), while Thailand, Viet Nam,

and Indonesia are among the top five exporting countries in the Asia-Pacific region, and the riparian countries of the South China Sea marine basin produce 23 percent of the world tuna catch and almost three-quarters of the world's canned tuna. Majority of the Southeast Asian region's fisheries are small-scale in nature, and fish are landed in a large number of decentralised locations for distribution through complex marketing networks at the community level.

Majority of the Southeast Asian countries are among the top 20 marine capture fisheries producing countries in the world (Fig. 2), with some experiencing annual increases in production of up to 5 percent. Pelagic fishes dominate landings by volume and value, as most demersal fisheries are over-exploited. It is well accepted, however, that regional fisheries statistics rarely reflect: (a) production from small-scale coastal fisheries, (b) the high level participation of coastal communities in fishing, or (c) the social and economic importance of artisanal and subsistence fishing to coastal communities. Fish stocks of this basin are subject to high levels of fishing effort, such that stocks of most economically important species are considered to be fully fished or overexploited.

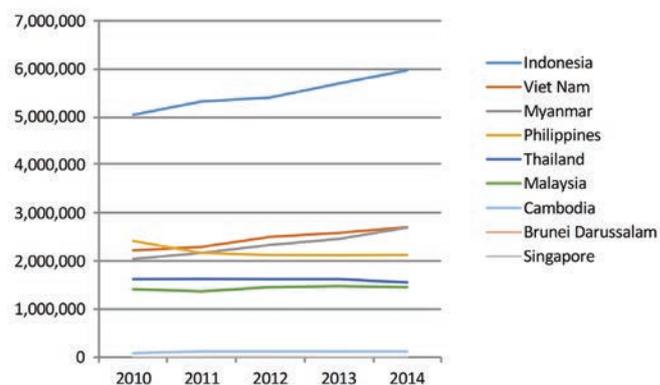


Fig. 1. Production of Southeast Asian countries from marine capture fisheries in 2010-2014

(Source: Fishery Statistical Bulletin of Southeast Asia 2014 (SEAFDEC, 2017))

Table 1. Fishery production of Southeast Asian countries by sub-sector from 2010-2014 (in million metric tons)

	2010	2011	2012	2013	2014
World's Total	78,910	83,696	80,836	82,246	82,756
Africa	5,152	5,049	5,704	5,546	5,799
America	17,445	22,441	18,392	18,817	16,858
Asia**	26,488	26,665	26,960	27,134	28,452
SE Asia***	14,874	15,095	15,591	16,152	16,655
Europe	13,756	13,271	12,919	13,387	13,660
Oceania	1,195	1,175	1,270	1,210	1,332

\* Source of main data: FAO Fisheries and Aquaculture Information and Statistics Service

\*\* Excludes Southeast Asia

\*\*\* Source: Fishery Statistical Bulletin of Southeast Asia 2014 (SEAFDEC, 2017)

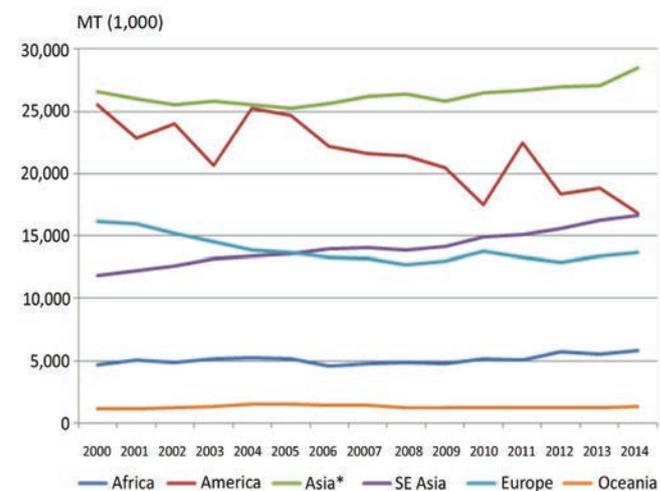


Fig. 2. Global trend in marine capture fishery production (Asia\* excludes Southeast Asia)

Increasing global demand for fisheries products and the dependence of coastal communities on fish for food and income had resulted in continued increases in fishing effort, and led to an increasing dependence of the artisanal sector on small pelagic species due to declining availability of demersal species. Overall, the total fisheries production of Southeast Asia has been contributing more than 20 percent to the world's total fisheries production (**Table 2**).

**Table 2.** Total fishery production by continent (2010-2014)\*, in million metric tons

	2010	2011	2012	2013	2014
<b>World's Total</b>	177.6	177.3	182.4	191.1	195.7
Africa	9.2	9.3	10.1	10.1	10.5
America	25.7	25.7	21.9	22.4	20.8
Asia**	91.1	91.1	93.2	100.4	103.8
SE Asia***	33.5	33.5	39.6	40.2	42.2
Europe	16.7	16.3	16.1	16.6	16.9
Oceania	1.4	1.4	1.5	1.4	1.5

\* Source of main data: FAO Fisheries and Aquaculture Information and Statistics Service

\*\* Excludes Southeast Asia

\*\*\* Source: Fishery Statistical Bulletin of Southeast Asia 2014 (SEAFDEC, 2017)

Declining fish availability, coupled with over-capacity and the dependence of the small-scale fisheries sector on coastal fisheries for income generation, has led to the adoption of destructive fishing practices by some fishers in order to maintain incomes and food production in the short-term. Fisheries trends suggest that production from capture fisheries will decline over coming years unless total fishing effort and capacity are reduced. The obvious problem in the reduction of fishing capacity is that most fisheries are small-scale with the majority of participants (and their families) being highly dependent on fisheries for income, food and well-being.

China (41 million metric tons), Viet Nam (3 million metric tons), Indonesia (3 million metric tons), and Thailand (1.2 million metric tons) are among the top ten aquaculture producers by volume worldwide, and in the top ten aquaculture producing states by value (FAO, 2014). In Southeast Asia, highly priced crustaceans account for 47 percent of total aquaculture production by value. Four of the five top shrimp producers in the world are states bordering the South China Sea (China, first; Thailand, second; Viet Nam, third; and Indonesia, fourth, whereas the Philippines is among the world's top ten shrimp producing countries (FAO, 2014). Giant tiger shrimp (*Penaeus monodon*) is the top produced species, although this position is being challenged by increased production of the white leg shrimp (*Penaeus vannamei*) by all countries, except Cambodia. The high dependence of the aquaculture sector on marine shrimp production has, and continues to contribute, to the loss of habitats bordering the South China Sea. Shrimp pond construction and the release of waste water from shrimp farms also contribute to localised coastal water

quality problems, particularly in areas of south-central Viet Nam and the western Gulf of Thailand (UNEP, 2008).

### Threats to Dominant Coastal Habitats

Degradation of mangrove habitats as a consequence of chronic pollution from shrimp and fish farming operations is now considered a key contemporary threat to mangroves, while charcoal production continues to degrade mangroves in Cambodia, Indonesia and the Philippines despite legislation banning all harvesting of mangroves in Cambodia and the Philippines (UNEP, 2008). At regional level, the following are seen as the current anthropogenic threats to mangrove systems bordering the South China Sea: reclamation and infrastructure development; pollution from shrimp farming; and conversion to industrial uses. On a smaller scale, trade in charcoal derived from mangroves in Cambodia to Thailand was, until very recently, a major cause of mangrove loss in the areas of Cambodia close to the Thai border.

This market appears to have declined somewhat over recent years under the influence of more widespread use of cheap and convenient liquefied natural gas in Thailand (UNEP, 2008). The functions of coastal vegetation, particularly mangroves, in terms of providing vital services with measurable economic benefits as protection against hurricane damage and marine-based flooding is becoming better appreciated in national and provincial development planning in the region.

Not only are the coral reefs of Southeast Asia the most biologically diverse and productive reef ecosystems in the world but they are also the most threatened and damaged with unprecedented rates of destruction from anthropogenic pressures that have accelerated over recent decades. The primary regionally significant threats to coral reefs in the South China Sea having been identified in order of significance are: over-fishing, use of destructive fishing techniques, pollution (mainly eutrophication), and increased sedimentation. Indirect causes of these threats are unsustainable practices in



More than 11 percent of the world's remaining mangroves border the South China Sea



Overfishing and destructive fishing practices are the leading causes of coral reef degradation in the region

the fisheries sector, coastal development, deforestation, and unsustainable tourism. Coral bleaching is also considered a serious threat to coral reefs in the region.

Additionally, the loss of sea grass from the basin is occurring at alarming rates. Indonesia has lost about 30-40% of its sea grass beds with as much as 60% being destroyed around Java. In Singapore, the patchy sea grass habitats have suffered severe damage largely through burial under landfill operations. In Thailand, losses of sea grass beds amount to about 20-30% and in the Philippines it is about 30-50%. The primary threats to sea grass include: the use of destructive fishing gears such as push nets and demersal trawl nets; increased sedimentation from coastal development; waste water effluent discharges; nutrient discharges and runoff; coastal construction; and over-fishing.

Population growth and urbanization of the coastal fringe combined with rapid economic growth in the South China Sea region place tremendous pressure on the coastal wetland ecosystems. Major threats to the coastal wetlands bordering the South China Sea can be grouped as follows: loss of wetland areas through conversion for agriculture, aquaculture, port and



The rate of loss of critical fisheries habitats such as sea grass has been estimated to be as high as 30 percent per decade

harbor development, human settlement, tourist development, urbanization, and industrialization. Wetland ecosystems are also highly degraded as a result of over-exploitation of living resources, use of inappropriate fishing techniques and gear, pollution, deforestation in upland area, introduction of invasive species, global trends and natural episodic events such as sea-level rise, typhoons and tsunami. In Indonesia, the conversion of wetland areas for palm oil plantations presents a high threat to coastal wetlands bordering the South China Sea. Overall it has been estimated that around 30% of coastal wetlands are lost in Southeast Asia each decade giving an approximate annual loss in value of 3% per annum.

### Threats from Land-based Pollution

Excessive nutrient loads and suspended solids are among the most common problems arising from land-based pollution in the coastal waters of countries bordering the South China Sea. High concentrations of suspended solids largely result from poor land-use practices, including logging activities and conversion of forests in upland areas. On the other hand, high nutrient loads mainly resulting from untreated domestic wastes, and waste from intensive animal husbandry are directly discharged into the receiving water bodies. Both types of contaminant impact the ecological functioning of coastal ecosystems. In addition, heavy metals such as mercury (Hg), Arsenic (As) and lead (Pb), have tended to increase in both biota and sediments in coastal waters of the South China Sea during the last decade.

The contaminants entering the marine environment have a number of impacts in terms of living resource and ecosystem degradation and potential impacts on aquaculture, food quality of export products, and human health. It must however be pointed out that almost all these pollutants are localized. Modeling of the spread of nutrients (UNEP, 2007i) strongly suggests that the present and projected nutrient pollution rates will have minimal effects on the South China Sea and Gulf of Thailand as a whole.



Effluent discharges from fish and shrimp aquaculture is one of contemporary causes of mangrove degradation

## Threats from Fishing

Over-capacity in commercial and small-scale fisheries, and the combined problem of over-exploitation, is an enduring issue facing regional fisheries. The impacts of over-capitalization and over-exploitation are magnified by the use of subsidies and the dependence of coastal communities on fish resources for income, as well as food and nutritional security. For example, the Phu Quoc Island District of Viet Nam is significant in terms of its coral reef and sea grass ecosystems, overall employment in its marine capture fisheries, fisheries production and related export earnings, and tourism (both domestic and international). However, over-capitalization and over-exploitation are issues that not only threaten the sustainability of fisheries in the area, but also the coral reef and sea grass habitats upon which fisheries and other sectors (e.g. tourism) depend.

The number of fishing vessels and total engine capacity (hp) in the area has increased rapidly over recent decades, and although there has been a general increase in landings throughout this period, catch per unit of effort (CPUE) has declined significantly. The use of destructive and unselective fishing gear and practices is prevalent across a range of fisheries and habitat types in the South China Sea. For example, destructive and/or unsustainable fishing gear and practices have been identified as key threats to fish stocks and their habitats in the mangrove areas at Trat in Thailand and at Batu Ampur in Indonesia, the extensive sea grass areas of Bolinao in the Philippines and Kampot in Cambodia, and at the regionally significant coral reef areas at Belitung in Indonesia, Masinloc in the Philippines, and Phu Quoc in Vietnam.

Push netting and inshore trawl fishing cause habitat impacts and selectivity issues. Catches of these gear types from inshore waters are largely composed of juveniles, and at high fishing effort levels are thought to contribute to the growth of over-fishing in South China Sea basin. Such a situation hinders fisheries management efforts which largely focus on



Balancing the dependence of small scale fisherfolk on fish for food and income with commercial interests remains a key barrier to the reduction of fishing capacity in the South China Sea

development of sustainable livelihoods, and is a key threat in inshore where push nets are used extensively over sea grass beds to take the juveniles of economically important species. Digging and gleaning of sea grass beds and mangrove forests is an area of concern at a majority of the priority *refugia* sites in the South China Sea. Growing demand for seafood in local markets has resulted in a marked increase over recent years in the number of people digging for sipunculid worms, gastropods, and crustaceans in sea grass beds, leading to damage of sea grass plants, de-stabilization of sediments (and subsequent erosion), and the over-exploitation of benthic organisms. Intensive digging and grazing in some mangrove areas is considered to be contributing to the occurrence of dwarf, low-density mangrove stands at several sites due to disturbance of mangrove roots and seedlings.

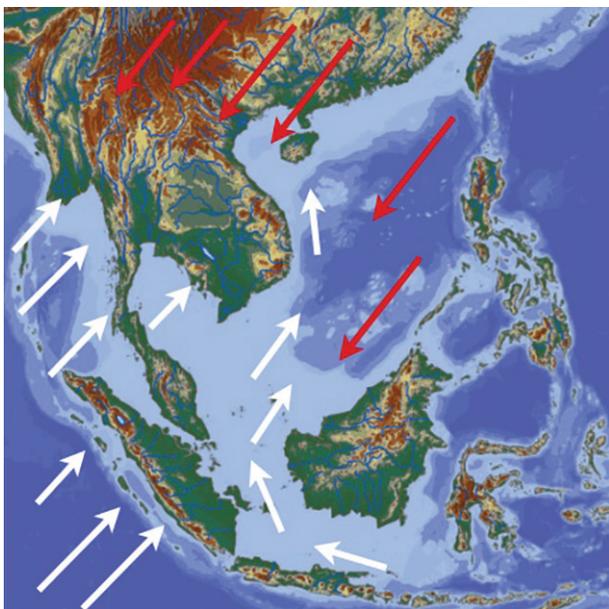


Small-scale fisherfolk are becoming increasingly dependent on small pelagic species as a result of the overexploitation of coral reef associated and demersal species

Blast fishing, and use of poisons and unselective fishing gears and practices are well-known and documented threats to fisheries and habitats in nearly all areas of the South China Sea. These fishing practices often result in mortalities of wide range of size-classes of target and non-target species, contributing to both growth and recruitment overfishing. The effects of blasting on the physical structure of coral communities is of particular concern, and the occurrence of blast fishing “craters” on heavily blasted reefs has a major impact on coral reef-associated fish assemblages. Non-selective fishing gears, such as trammel nets, are utilized in most fished coral reef areas along the South China Sea coast. The growing need to minimize the impacts of such practices on critical habitats necessitates the development of best practices in the management of these problems.

## Threats Associated with Climate Variability and Change

The uncertainty and extremes of climate variability compound and exacerbate the social and economic challenges faced by coastal communities of East Asia. Large-scale features such as the Inter-tropical Convergence Zone and the West Pacific Monsoon drive the seasonal variations in rainfall experienced in the Western Pacific Ocean, including wet and dry seasons. Together, they influence rainfall, winds, tropical cyclones, ocean currents and other aspects of the weather and climate. While these features drive the wet and dry seasons experienced annually in most of the riparian countries of the South China Sea, the single greatest factor affecting climate variability from year to year is the El Niño/La Niña Southern Oscillation or ENSO. This cycle of warming and cooling of sea surface temperatures of the Western Pacific has a profound effect on the hydrological cycle of East Asian countries, driving periods of drought and elevated rainfall across the region. The effects of the ENSO cycle are not restricted to drought. It is also a driver of periods of elevated rainfall and rainfall intensity, and plays a significant role in both suppressing and stimulating the propagation and severity of tropical cyclones, all of which have significant impacts on the people and economies of coastal communities. However, while regional understanding of climate variability and change has improved considerably over the past years, this improvement has not translated into a corresponding increase in community resilience.



(Source: Google)

Southeast Asian monsoon: Northeast (November-March) and Southwest (May-September)

Overall, beaches of the South China Sea coasts with stable beach plan forms which currently receive sediments inputs via longshore drift will, under increased sea level receive lower inputs of sediments resulting in consequent beach erosion and shoreline retreat. The extent of this retreat will

depend on the profile of the terrestrial-marine interface and the current importance of sediments derived from longshore drift. Depending on the rate of sediment input into the coastal system from riverine sources, the system can be expected to stabilize only if sea level itself stabilizes, and only following filling of the transitory sinks in the system (estuarine and beach sinks). In areas of reduced rainfall, riverine sediment inputs may be reduced further exacerbating coastal erosion. In areas of higher rainfall, riverine sediment inputs may not be significantly increased depending on the nature of the vegetation cover. Additionally, beach plan forms will be changed by changing wave patterns resulting from modification of regional and sub-regional wind patterns. Such changes will be of significance for coastal ecological communities, particularly sea grass meadows, coral flats and algal beds.

In estuarine areas, an inland extension of the tidal prism may be expected. In coastal plains, saltwater contamination of the groundwater may have profound effects on both the suitability of areas for human occupation and the nature of the vegetation. A rise in sea level will also cause a rise in the water table which may have important consequences for freshwater lenses which currently float on saline water bodies. Such influences are also linked to compression of the marine-terrestrial transition, particularly in areas currently having flat coastal plain, where changes in coastal vegetation following sea level rise and inundation may be dramatic. Zonation is likely to be compressed, particularly in mangrove areas, resulting not only in an overall reduction in the extent of such transitional habitats but also extensive reduction in the seaward sides. Such coastal habitat reduction will result in important changes to the distribution and abundance of species of subsistence and economic importance, and a general loss of estuarine and mangrove species. In general, declines in both individual species abundance and species richness are anticipated. Increased turbidity, linked to more intense or frequent rainfall, will also likely affect shallow water primary producers, including corals, sea grass and macro-algae.

## SDG 14 and the Management of Threats to Fish Life-Cycle and Critical Habitat Linkages

Although action aimed at reducing the rate of loss of coastal habitats has been implemented by countries bordering the South China Sea, the decadal rate of loss of such habitats remains high, e.g. sea grass beds (30 percent), mangroves (16 percent), live coral reef cover (16 percent), and wetlands (30 percent) (UNEP, 2008). This continued decline in the total area of habitats critical to the life cycles of most aquatic species, combined with the high levels of coastal community dependence on fish, has raised serious concerns for the long-term sustainability of small-scale fisheries in the region. This situation of high small-scale fishing pressure and declining fisheries resources has contributed to the adoption of unsustainable fishing methods to maintain catch and

increase incomes in the short-term. These include the use of destructive fishing gear and practices, such as the operation of demersal trawls and push nets in sea grass areas, and illegal fishing practices such as dynamite fishing and release of fish poisons in coral reef areas. Small-scale inshore fishing pressure has therefore been identified as a significant cause of the degradation and loss of coastal habitats in the South China Sea (UNEP, 2008).

With fish production being intrinsically linked to the quality and area of habitats and the heightened dependence of coastal communities on fish, a need exists to improve the integration of fish habitat considerations and fisheries management in the region. The dilemma for the fisheries and environment sectors is that conservation of habitat does not necessarily result in increased fish stock while lowering fishing effort does not necessarily result in the improvement of habitats. Therefore, given the complexity of the key threats to fish stocks, fish habitats and associated biodiversity in Southeast Asia, it is imperative that mechanisms for effective cross-sectorial consultation and coordination be established, particularly in terms of the identification and designation of priority ‘places’ (sensu Pauly, 1997) for management. The South China Sea

**Box 1. Related end-of-project targets of the Strategic Action Programme for the South China Sea**

- By 2020, to have established a regional system of a minimum of fourteen *refugia* for the management of priority transboundary, fish stocks and endangered species
- By 2020, to have prepared and implemented fisheries management systems in the identified priority *refugia* based on and consistent with, the ASEAN SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia

Fisheries *Refugia* Initiative was developed to meet this need via implementation of the fisheries component of the Strategic Action Programme for the South China Sea.

The longer-term goals of this project are to contribute to: improved integration of habitat and biodiversity conservation considerations in the management of fisheries in the South China Sea and Gulf of Thailand; improved national management of the threats to fish stock and critical habitat linkages within fisheries *refugia*; and enhanced uptake of good practice in integrating fisheries management and biodiversity conservation in the design and implementation of regional and national fisheries management systems. The medium-term objectives align with those of the fisheries component

**Box 2. Anticipated outcomes aligning with several targets of SDG 14 ‘Life Under Water’**

**SDG Target 14.2** ‘By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans’

The internationally agreed indicator for progress against this target is the ‘Proportion of national exclusive economic zones managed using ecosystem-based approaches’. The South China Sea Fisheries *Refugia* Initiative is working to support this by strengthening the enabling environments for formal designation and operational management of *refugia* in the six participating countries. Key activities include legal reviews to identify, inter alia: legal terminology for describing *refugia*; formal procedures for demarcating boundaries of spatial management areas such as *refugia*, including requirements for assessing the socio-economic impacts of management measures and stakeholder consultations; and provisions for decentralizing *refugia* management to the community level via development of co-management and rights-based approaches. This is aimed at facilitating the drafting of required policy and legislative amendments for adoption by competent authorities. This component will also build the national and site-level science and information base required to enhance the monitoring and evaluation of the effectiveness of individual *refugia* and the regional network of sites.

**SDG Target 14.4** ‘By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics’

Progress towards the achievement of this target will be measured on the basis of the ‘Proportion of fish stocks within biologically sustainable levels’. While many fisheries management arrangements focus on achieving maximum sustainable exploitation of resources it is also important to acknowledge the inherent complexity in fisheries system and that Southeast Asian is a region with relatively scarce information and data relating to stock status and fishing pressure. Accordingly, it is inevitable that fisheries management will continue to take place in situations where there is irreducible uncertainty due to the massive and difficult information problems associated with describing and understanding most fisheries. This is especially true in the case of the Gulf of Thailand, where fisheries management must balance the interests of multiple jurisdictions, coastal community dependence on fisheries for food security, the problem of overfishing, destructive fishing practices, and the inherently complex nature of the tropical multispecies fisheries of the region. This initiative will support efforts to sustainably manage fish stocks within their biological limits by reducing growth and recruitment overfishing via targeted actions to safeguard fish stock and critical habitat linkages at times and within locations where there are high abundances of (a) stock in spawning condition or (b) juveniles and pre-recruits.

**SDG Target 14.5** ‘By 2020, conserve at least 10 percent of coastal and marine areas, consistent with national and international law and based on the best available scientific information’

Progress against this target will be measured in terms of the total hectares of managed areas. The South China Sea Fisheries *Refugia* Initiative will contribute to this through the establishment of operational management at 14 priority fisheries *refugia* with a total area of approximately 270,000 hectares. This will be supported by consultative processes to facilitate agreement among stakeholders on the boundaries of fisheries *refugia*, identification of key threats to *refugia* sites, recording of fishing community views regarding appropriate fisheries and habitat management measures, and eliciting stakeholder inputs to management plan development and review. *Refugia* management plans will provide rules inter alia on operating requirements for the use of particular classes of fishing vessels or fishing gear within *refugia*, procedures for adjusting management measures over time, and mechanisms for enforcement. Specific direction is given to drafting of regulations and ordinances required in support of plan implementation.

of the Strategic Action Programme for the South China Sea which are to: build the resilience of Southeast Asian fisheries to the effects of high and increasing levels of fishing effort; improve the understanding among stakeholders including fisherfolk, scientists, policy-makers, and fisheries managers of ecosystem and fishery linkages as a basis for integrated fisheries and ecosystem and habitat management; and build the capacity of fisheries departments or ministries to engage in meaningful dialogue with the environment sector regarding the improvement of fisheries and management of interactions between fisheries and critical marine habitats. The related end-of-project targets are shown in **Box 1**.

While **SDG 14** ‘Life Below Water’ is of high level significance to the work of SEAFDEC and its Member Countries in the promotion of sustainable fisheries, activities of the South China Sea Fisheries *Refugia* Initiative will have a number of additional impacts towards the achievement of SDGs which cut across the work of promoting sustainable fisheries in the Southeast Asian context. These include the goals that relate to: No Poverty (**Goal 1**); Zero Hunger (**Goal 2**); Gender Equality (**Goal 5**); Decent Work and Economic Growth (**Goal 8**); Responsible Consumption and Production (**Goal 12**); and Climate Action (**Goal 13**). For example, the focus of the Initiative on securing sustainable livelihoods and nutritional security will contribute to the achievement of **SDG Target 2.1** that ‘By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round’. Similarly, efforts to promote gender equality in the execution of the initiative will contribute towards the achievement of **SDG Target 5.a**: ‘Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws’. The anticipated outcomes align with several targets of **SDG 14** ‘Life Under Water’ and are shown in **Box 2**.



The fisheries *refugia* initiative is part of broader SEAFDEC initiatives to foster sustainable fisheries in Southeast Asia

## Conclusion

The SDGs are widely acknowledged as ‘aspirational’ global goals for sustainable development. The goal and targets relating to ‘Life Below Water’ are of high level of significance to the 270,000,000 people residing in coastal areas of the South China Sea marine basin and have been identified as being at the highest risk globally from continued coastal and marine environmental degradation. However, with this large population come a number of threats to coastal and marine biodiversity, dominant coastal habitats, and the sustainability of fisheries. For example, the rate of loss of critical fisheries habitats from the basin is high and increasing and is an issue of high regional concern from the perspective of food security and livelihoods. However, turning this scenario around within the 2020 timeline for the **SDG 14** targets relating to sustainable fisheries must be acknowledged as being highly ambitious given the range of challenges the region’s fisheries face. These include difficulties associated with the management of fishing capacity, IUU fishing practices, and high-level of dependence of the small-scale fishing sector on fish for food and incomes.

While the South China Sea Fisheries *Refugia* Initiative will make contributions towards the achievement of several of the **SDG 14** targets and other goals, it will be necessary for this initiative to be effectively coordinated with the broad range of efforts of SEAFDEC, its Member Countries, and other development partners in the promotion of sustainable fisheries in Southeast Asia. Such coordination and partnership will be essential in realizing the full range of benefits possible.

## References

- Briggs, J.C., 2005a. The Marine East Indies: diversity and speciation, *Journal of Biogeography* 32: 1517–1522
- Briggs, J.C., 2005b. Coral reefs: conserving the evolutionary sources, *Biological Conservation* 126: 297–305
- Burke, L., Selig, E. and Spalding, M., 2002. Reefs at Risk in Southeast Asia. World Resources Institute, Washington, DC.
- Hoeksema B.W., Dautova, T.N., Savinkin, O.V., Vo, S.T., Hoang, X.B., Phan, K.H. and Hoang, T.D., 2010. The Westernmost Record of the Coral *Leptoseris kalayaanensis* in the South China Sea. *Zoological Studies*, 49(3): 325
- FAO, 2014. The State of World Fisheries and Aquaculture: Opportunities and Challenges. Food and Agriculture Organization of the United Nations, Rome. 243 p
- International Hydrographic Organization (IHO), 1953. Limits of Oceans and Seas. Third Edition
- IOC-UNESCO and UNEP, 2016. Large Marine Ecosystems: Status and Trends, Summary for Policy Makers. United Nations Environment Programme (UNEP), Nairobi, Kenya
- Licuanan, W.Y., 2009. Guide to the common corals of the Bolinao-Anda Reef Complex, Northwestern Philippines. University of the Philippines Marine Science Institute. Diliman, Quezon City, Philippines; 174 p

- Pauly, D. 1997. Points of View: Putting fisheries management back in places. *Reviews in Fish Biology and Fisheries*, 7:125-127
- Paterson, C.J., Pernetta, J.C., Siriraksophon, S., Kato, Y., Barut, N.C., Saikliang, P., Vibol, O., Chee, P.E., Nguyen, T.T.N., Perbowo, N., Yunanda, T., Armada, N.B., 2013. Fisheries *refugia*: A novel approach to integrating fisheries and habitat management in the context of small-scale fishing pressure. *Ocean and Coastal Management*, 85(b): 214-229
- Polidoro, B.A., Carpenter, K.E., Collins, L., Duke, N.C. Ellison, A.M., Ellison, J.C., Farnsworth, E.J., Fernando, E.S., Kathiresan, K., Koedam, N.E., Livingstone, S.R., Miyagi T., Moore, G.E. Nam, V.N., Ong, J.E., Primavera, J.H, Salmo III, S.G., Sanciangco, J.C., Sukardjo, S., Wang, Y., & Yong, J.W.H., (2010) The loss of species: mangrove extinction risk and geographic areas of global concern. *PLoS ONE*, 5, e10095, Doi: 0.1371/journal.pone.0010095
- Spalding, M., Kainuma, M., and Collins, L., (2010) *World Atlas of Mangroves*. Earthscan, London, UK
- SEAFDEC. 2017. *Statistical Bulletin of Southeast Asia 2014*. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 153 p
- Sudara, S., Fortes, M., Nateekanjanalarp, Y. and Poovachiranon, S., 1994. Human uses and destruction of ASEAN seagrass beds, 110-113. In Wilkinson, C.R. (ed.) *Living Coastal Resources of Southeast Asia: Status and Management*. Report of the Consultative Forum Third ASEAN-Australia Symposium on Living Coastal Resources, May 1994, Thailand. Australian Agency for International Development, 133 p
- Tomascik, T., Mah, A.J., Nontji, A. and Moosa, M.K., 1997. *The Ecology of the Indonesian Seas. Part 1*. Dalhousie University, Periplus Editions (HK) Ltd, 642 p
- Tu, T.L.H., Nguyen, V.T. Le, T.T. 2002. Some studies on seagrass communities in Phu Quoc islands, Kien Giang Province. *Proceedings of Scientific Conference “Bien Dong-2002”*. Nha Trang, Viet Nam: 369-376
- UNEP, 2007. *National Reports on Coral Reefs in the Coastal Waters of the South China Sea*. UNEP/GEF/SCS Technical Publication No. 11
- UNEP, 2008. *Strategic Action Programme for the South China Sea*. UNEP/GEF/SCS Technical Publication No. 16
- United Nations. 2015. *United Nations Resolution A/RES/70/1 of 25 September 2015 - Transforming our world: the 2030 Agenda for Sustainable Development*. UN Sustainable Development Summit, 25-27 September 2015, New York, U.S.A.S., 35 p
- Veron, J. E. N., 1995. *Corals in space and time. The biogeography and evolution of the Scleractinia*. University of New South Wales press. 321 p
- Vo, S.T., DeVantier, L., Nguyen, V.L., Hua, T.T. Nguyen, X.H., Phan, K.H., 2002. *Coral Reefs of Hon Mun Marine Protected Area, Nha Trang Bay, Vietnam: 2002. Species composition, community structure, status and management recommendations*. *Proceeding of Scientific Conference “Bien Dong – 2002”*. Agricultural Publishing House, 2004: 649 – 690
- Vo, S.T., Pernetta, J.C. and Paterson, C.J., 2013. Status and trends in coastal habitats of the South China Sea. *Ocean and Coastal Management*, 55(B): 153-163

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# Highlighting SDG 14 in the Development and Management of Southeast Asian Marine Capture Fisheries

Suppachai Ananpongsuk, Kongpathai Saraphaivanich, Suthipong Thanasarnsakorn, and Jariya Sornkliang

Guided by the series of ASEAN-SEAFDEC Resolutions and Plans of Action on Sustainable Fisheries for Food Security for the ASEAN Region, the Southeast Asian Fisheries Development Center (SEAFDEC) has been continuously promoting sustainable management of marine capture fisheries in the Southeast Asian region through a number of projects implemented by SEAFDEC Training Department (TD) and SEAFDEC Marine Fishery Resources Development and Management Department (MFRDMD). Specifically, the 2001 Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region included provisions under A (Fisheries Management), on the need to: **A(3)** - take measures to prevent unauthorized fishing and eliminate the use of illegal and destructive fishing gears and practices by building awareness of their adverse impacts, the development and promotion of responsible and selective fishing gears and practices, enforcing regulations and encouraging alternative means of livelihood; and **A(5)** - review the issue of excess fishing capacity at the national level and recommend where appropriate, measures to improve registration of fishing vessels, the introduction of rights-based fisheries and the reduction in the number of fishing boats and level of fishing effort using government incentives. In the subsequent 2011 Plan of Action on Sustainable Fisheries for Food Security for the ASEAN region Towards 2020, some provisions were focused on the need

to: **B(21)** - strengthen regional and national policy and legislation to implement measures and activities to combat IUU fishing, including the development and implementation of national plans of action to combat IUU fishing, and promote the awareness and understanding of international and regional instruments and agreements through information dissemination campaigns; **B(22)** - establish and strengthen regional and sub-regional coordination on fisheries management and efforts to combat IUU fishing including the development of regional/sub-regional Monitoring, Control and Surveillance (MCS) networks; and **B(29)** - recognizing the different management approaches that are required, sustainably manage major critical coastal habitats, such as mangroves, coral reefs and sea grasses; and develop and disseminate information and guidance on appropriate tools and interventions. In a later development, concerns related to the sustainable development of fisheries in the ASEAN region were raised to higher level resulting in the development and adoption of the ASEAN-SEAFDEC Joint Declaration on Regional Cooperation for Combating IUU Fishing and Enhancing the Competitiveness of ASEAN Fish and Fishery Products in August 2016. The various relevant provisions serve as framework for the development of programs and activities undertaken by SEAFDEC to promote the sustainable development of fisheries in the Southeast Asian region.

From the outset, SEAFDEC had been exerting efforts to promote effective management of fisheries and strengthen the sustainable exploitation of the region's marine fishery resources, and in order to obtain clear picture of the status of the region's fishing capacity, SEAFDEC convened several regional consultations. Recommendations from such consultations pointed towards the need to combat illegal, unreported and unregulated (IUU) fishing in the waters of Southeast Asia as IUU fishing undermines the sustainable development of fisheries in the region. The ASEAN Member States (AMSs) agreed that initially, efforts to combat IUU fishing could start with improving fishing vessel registration and fishing licensing systems in the region, and development a mechanism for sharing the relevant information among the countries as appropriate.

Thus, a movement ensued in the AMSs to address issues on excess fishing capacity not only through registration of fishing vessels and licensing of fishing operations but also through the promotion of enhanced Monitoring, Control and Surveillance (MCS) systems for all fishing operations as well as port monitoring and control. Moreover, open access to fishery resources had been gradually replaced with limited

access regimes, while cooperation for combating IUU fishing in the region had been strengthened in order to improve the total marine fisheries production of the region, which appears to be leveling off except for Indonesia, as shown in **Fig. 1**. Considering that the region's production from marine capture fisheries had been considerably contributing substantial amount to the region and the world's total fisheries production, as shown in **Fig. 2**, it was deemed necessary that the region's marine capture fisheries should be managed in a sustainable manner.

For its part, SEAFDEC has been assisting the AMSs in their efforts to combat IUU fishing through the implementation of the project on Promotion of Sustainable Fisheries and IUU-related Countermeasures in Southeast Asia. Initiated in 2010, the project was funded by the Government of Japan through the Japanese Trust Fund (JTF) and included among others, the activity on the Promotion of Fishing License, Boats Registration and Port State Measures (Matsumoto *et al.*, 2012). This activity had four main components that point towards developing countermeasures to reduce IUU fishing, namely: promotion of fishing licensing, boats registration and port state measures as fisheries management tool to combat

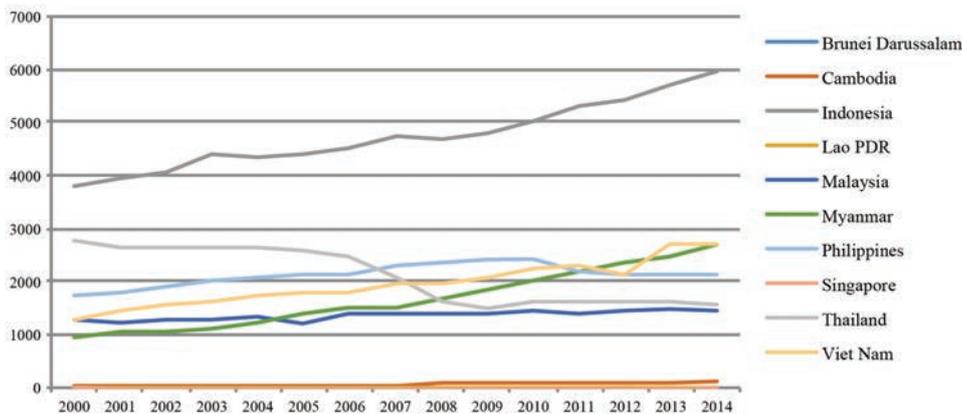


Fig. 1. Trend of Southeast Asia's production from marine capture fisheries (in '000 MT)

Source: SEAFDEC (2017)

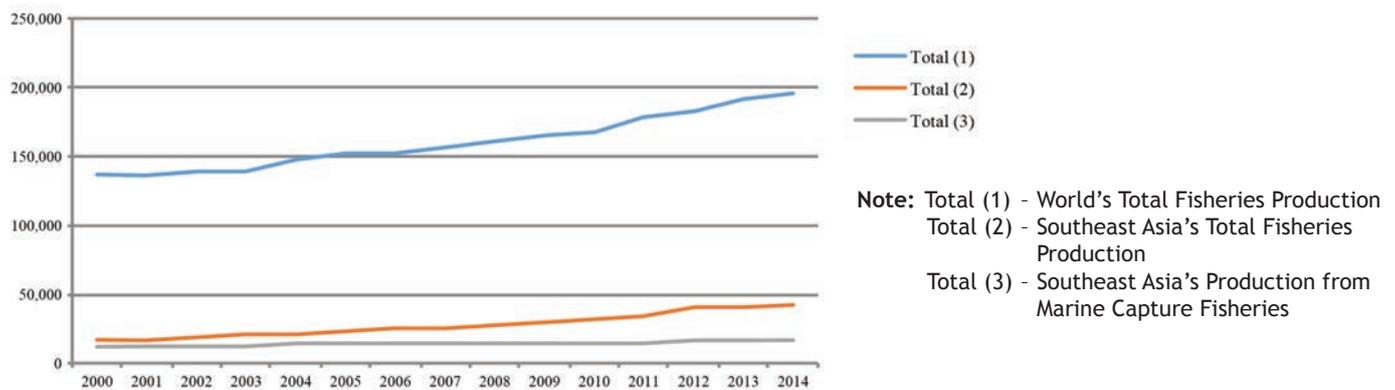


Fig. 2. Contribution of the Southeast Asia's production from marine fisheries to the total fisheries production of Southeast Asia and the world (in '000 metric tons)

Source: SEAFDEC (2017)

IUU fishing; promotion of MCS management for sustainable fisheries in the region; preventing IUU fishing operations and its products from being exported; and assistance to the AMSs in the application and implementation of IUU fishing-related countermeasures.

### Development of Regional Fishing Vessels Record to Reduce IUU Fishing in Southeast Asia

The project on the Promotion of Sustainable Fisheries and IUU Fishing-related Countermeasures in Southeast Asia which includes the Promotion of Fishing License, Boats Registration, and Port State Measures in Southeast Asia paved the way for the development of a regional record of fishing vessels starting with vessels measuring 24 meters in length and over during its first phase, to be expanded later with the recording of vessels measuring less than 24 meters (Pongsri, *et al.*, 2014). In carrying out the abovementioned activity, SEAFDEC convened a series of regional consultations to compile the necessary information for the development of the regional record of fishing vessels, while the minimum requirements for fishing licensing and boats registration in the region have also been harmonized as agreed upon during the

consultations taking into consideration the existing practices in the AMSs (SEAFDEC/TD, 2011; SEAFDEC/TD, 2012).

Thus, SEAFDEC in collaboration with the AMSs developed the "Regional Fishing Vessels Record (RFVR) Database" for 24 meters in length and over, as a management tool to combat and reduce IUU fishing for the sustainability of fisheries in the region, and address the concern on severe fishery resources degradation in the Southeast Asian region brought about by uncontrolled practices of IUU fishing. In addition, SEAFDEC has since then been extending assistance to the countries in the region in their endeavors to improve their respective fishing licensing systems that conform to regional and international requirements.

The RFVR Database is an online system and a collaborative initiative of the AMSs with the intention of sharing information among AMSs on fishing vessels identification and other relevant data and information. The AMSs agreed on the 28 elements that would comprise the basic information requirements to be shared with the RFVR Database (SEAFDEC/TD, 2014). The specific objective of the RFVR is to provide the AMSs with reliable and rapid tools to share

information on AMS vessels engaged in “international fishing operations,” *i.e.* fishing operations in foreign country’s EEZ or in the high seas. The RFVR is expected to serve as a practical way of checking and taking corrective actions against inappropriate behavior of AMS fishing vessels, and means for related authorities of AMSs to support the elimination of IUU fishing in the Southeast Asian region (Pongsri *et al.*, 2014). For example, the AMSs can take appropriate actions against “double-flagging vessels, IUU fishing vessels, port State control and poaching” by sharing information and identifying problematic vessels through the information in the RFVR Database. Therefore, the RFVR can be described as a “Shared Tool for AMSs to Reduce IUU Fishing”, because RFVR could assist the AMSs in taking coordinated countermeasures against IUU fishing. Furthermore, it is also expected that if AMSs could make full use of the RFVR Database, reduction of IUU fishing activities in the region would be successfully achieved. The target users of the RFVR Database is categorized into three groups, namely: coastal State, flag State, and port State, involving many people such as enforcement officers, vessel inspectors, coastguards, marine polices, navy, vessel registration units, fishing license units, customs, immigration, quarantine units, ports authority, fisheries officers and managers, among others.

Moreover, SEAFDEC in collaboration with the AMSs had established a Regional Cooperation to support the effective implementation of port State measures (PSM). In addition to the standard approach, a harmonized approach would be developed in which implementation of PSM would be integrated, aligned with international and regional agreement/measures, and applied for all foreign-flagged vessels of the AMSs (SEAFDEC/TD, 2017). Such approach would also be linked to existing management tools such as the ASEAN Catch Documentation Scheme (ACDS), the ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the Supply Chain, and the RFVR.

Although the main responsibility of enforcing these IUU fishing countermeasures lies with the flag States, the role and functions of port States should also be strengthened



through the enforcement of relevant regulations to enhance the promotion of measures to combat IUU fishing. In this regard, SEAFDEC organized the Workshop on “Regional Cooperation for Implementation of Port State Measures to Improve Fisheries Management and Reduce IUU Fishing in Southeast Asia” in November 2019 in Bangkok, Thailand.

The Workshop was specifically meant to: enhance the understanding of the AMSs on the implications to the region of the entry into force of the Port State Measures Agreement (PSMA); update the issues that impede the adoption of the PSMA; update the status, constraints and problems encountered by the AMSs during the implementation of PSM; identify the capacity building needs to support the implementation of PSM in the region; and develop the SEAFDEC work plan to facilitate the implementation of PSM in the region.

### **Strengthening Fishery Resource Conservation and Stock Enhancement**

As SEAFDEC continues to promote the countermeasures to combat IUU fishing in the Southeast Asian region, in a parallel approach, it also implements projects that aim to mitigate the impacts of IUU fishing on the fishery resources. If uncontrolled, illegal fishing activities would prevent the recovery of stocks that had been overfished and degrade the fishery resources, therefore, as part of sustainable fisheries management, it is also necessary to safeguard the fish stocks through resource conservation, protection and rehabilitation (Theparoonrat *et al.*, 2016). Along this rationale, SEAFDEC has been conducting resource enhancement projects through two approaches, namely: improvement of critical habitats and nursing grounds of fishery resources; and direct enhancement of the fishery resources by artificial propagation techniques. The outputs of such projects are now being applied and implemented in most of the countries in the Southeast Asian region (Kawamura, *et al.*, 2016).

In order that the SEAFDEC Member Countries could share the experiences in the implementation of fishery resources enhancement activities in their respective countries, SEAFDEC organized the “Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region” in Pattaya, Thailand in 2015. The Symposium was also meant to address the need to enhance the fishery resources in the jurisdictions of the respective Southeast Asian countries as well as their transboundary areas due to the declining and/or over exploitation of several economically important fish stocks and the loss of relevant habitats. Thus, the Symposium had two main parts, *i.e.* Fishery Resources Enhancement through Habitat Improvement and Management, and Fishery Resources Enhancement through Artificial Propagation and Stock Release. As a result, the Symposium came up with the “Strategic Plan for Fishery Resources Enhancement in Southeast Asia,” which was endorsed by the SEAFDEC Council during its Forty-eighth Meeting in 2016 for implementation by SEAFDEC and the Member Countries (SEAFDEC, 2016a). Based on the said Strategic Plan, TD initiated a new project on the “Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia,” which initially includes selection of appropriate project sites, identification of the most effective resources enhancement tools and measures, and development of rehabilitation plans for various critical habitats and fishing grounds.



tuna in Sulu and Sulawesi Seas which was carried out using the M.V. SEAFDEC 2 in 2014 and 2015.

Recognizing the importance of mitigating the impacts of climate change by reducing carbon emission, SEAFDEC conducted capacity building activities on efficient energy use of fishing vessels in the Southeast Asian region. Energy audit is also being promoted as a useful and effective tool for trawler owners to identify the levels of energy consumption and associated cost of utilization. Energy audit is considered a systematic approach for identifying operational and mechanical changes that can be implemented to reduce energy consumption as well as potential savings once the changes are implemented. Energy audit also provides guidance regarding the type of changes that can be applied, the cost of installation and operation for such changes, and the amount of fuel that can be saved, and the return on investment or payback period of each recommended change (Chokesanguan *et al.*, 2015). In this connection, TD collaborated with FAO to gain understanding of energy consumption in fishing boats and develop related energy audit testing protocols.



Baseline data and the potential fuel savings in fishing vessels were collected in the Gulf of Thailand and Andaman Sea. Parameters such as catch per liter of fuel and distance per liter during steaming and towing were compiled for the second phase which aims to systematically evaluate the potential impact of fuel saving practices in fisheries, including their

### Understanding the Fishery Resources in Southeast Asia through Scientific Cooperation

SEAFDEC has been providing technical support to the AMSs in assessing the status of their fishery resources through the conduct of marine fishery resource surveys in their respective waters using the M.V. SEAFDEC 2. After the M.V. SEAFDEC 2 was granted to SEAFDEC by the Government of Japan in 2003, a number of resource surveys had been carried out in the waters of the region. The surveys include compilation and analysis of oceanographic data, fishing operation trials, and hydro-acoustic studies. One of the most recent collaborative research activities with the AMSs was the stock assessment of





suitability and relative contribution to fuel conservation. Analysis of the data compiled is being undertaken to identify, establish and evaluate the potential fuel saving options and protocols.

A pilot activity on extensive energy audit using Thai fishing vessels is now being carried out based on the experience of the initial energy audit conducted by TD, as well as the knowledge and skills obtained from such activity. SEAFDEC plans to continue this activity using improved equipment and data collection protocols, and collection of data to cover a span of at least six months in order that the data compiled would be more accurate and reflective of one fishing period.

### Enhancing Fisheries Management through Capacity Building

SEAFDEC also supports the small-scale fisheries to have access to marine and inland resources, and market through its project on “Facilitating Fisheries Activities and Information

Gathering through Community-based Fisheries Management.” Implemented by TD, the project is aimed at strengthening community fisheries organizations and providing capacity building for better development and management of the coastal and inland resources. The ultimate goal of the project is to ensure sustainable livelihoods in coastal communities through enhanced fisheries information gathering activities and introduction of community-based fisheries management (CBFM) in coastal and inland fishing communities in the Southeast Asia region.

The four main activities of the project are: (1) on-site training on the introduction of tools and methodologies for socio-economic surveys, as well as the appropriate participatory mechanism of co-management to foster the use in coastal small-scale and inland fisheries in the region; (2) monitoring and conduct of socio-economic surveys and practical training for fisheries officers at local fisheries community in the region; (3) compilation of information on CBFM practices of the countries in Southeast Asia and development of harmonized and appropriate approach for the Southeast Asian region; and (4) regional workshops in Cambodia, Malaysia, Myanmar, Lao PDR, Philippines, Thailand, and Viet Nam.



After the capacity building activities and workshops, the countries applied and adapted the knowledge, skills and experience in their respective countries. Thailand is one of the successful countries to have applied and adapted the knowledge on fisheries co-management in Num Oon Reservoir in Sakonnakorn Province.



Such effort was recognized by the Government of Thailand and gave the award for good fisheries co-management to Sakonnakorn Province in 2016. Moreover, to support fisheries management for small-scale coastal fisheries, SEAFDEC participates in the regional project of the Research Institute for Human and Nature (RIHN) of Japan on “Area Capability” under the component on socio-economics. This component focuses on the conduct of fishing household surveys along the coastal areas of the Gulf of Thailand during 2012-2015, notably in the provinces of Rayong, Prachaub Kiri Khan, Chumphon and Surat Thani. The ongoing surveys are meant to assess the situation of small-scale fishing communities and identify the capability of each area for sustainable fisheries development.

## References

- Bundit Chokesanguan, Steve Eayrs and Suthipong Thanasarnsakorn. 2015. Fishing Vessels Energy Audit: Operational Benchmarking of Fuel Consumption in Southeast Asian Trawl Fisheries – Pilot Project in Thailand. *In: Fish for the People Vol. 13 No. 2: 2015*. Southeast Asia Fisheries Development Center, Bangkok, Thailand; pp 43-47
- Chumnam Pongsri, Hajime Kawamura, Somboon Siriraksophon, and Bundit Chokesanguan. 2014. Regional Fishing Vessels Record: Option to Mitigate IUU Fishing in Southeast Asia. *In: Fish for the People, Volume 12 No. 1 (2014)*; Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 11-15
- Hajime Kawanura, Tsuyoshi Iwata, Yuttana Theparoonrat, Nopporn Manajit, and Virgilia T. Sulit. (Eds). 2016. Consolidating the Strategies for Fishery Resources Enhancement in Southeast Asia. Proceeding of the Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region, Pattaya, Thailand, 27-30 July 2015. Training Department, Southeast Asian Fisheries Development Center, Samut Pakan, Thailand; 185 p
- Kenji Matsumoto, Bundit Chokesanguan, Virgilia Sulit, and Kongpathai Saraphaivanich. 2012. Development of Regional Fishing Vessels Record as Tool to Combat IUU Fishing in Southeast Asia. *In: Fish for the People, Volume 10 No. 3 (2012)*; Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 12-16
- SEAFDEC. 2015. SEAFDEC Annual Report 2014. Southeast Asia Fisheries Development Center, Bangkok, Thailand; 80 p
- SEAFDEC. 2016. SEAFDEC Annual Report 2015. Southeast Asia Fisheries Development Center, Bangkok, Thailand; 84 p
- SEAFDEC. 2016a. Report of the Forty-eighth Meeting of the Council of the Southeast Asian Fisheries Development Center, 4-8 April 2016, Nha Trang, Viet Nam. Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 16
- SEAFDEC. 2016b. SEAFDEC Annual Report 2015. Southeast Asia Fisheries Development Center, Bangkok, Thailand; 84 p
- SEAFDEC/TD. 2011. Report of the Regional Core Experts Meeting on Fishing License, Boats Registration and Information on Export of Fisheries Products in Southeast Asia, 4-7 October 2011, Bangkok, Thailand. SEAFDEC Training Department, Samut Prakan, Thailand; TD/RP/153; 111 p
- SEAFDEC/TD. 2012. Report of the Experts Group Meeting on Fishing License and Boats Registration in Southeast Asia, June 2012. SEAFDEC Training Department, Samut Prakan, Thailand; TD/RP/162; 102 p
- SEAFDEC/TD. 2014. Regional Technical Consultation on the Regional Fishing Vessels Record: Use and Way Forward of RFVR Database as a Management Tool to Reduce IUU Fishing in Southeast Asian Region. SEAFDEC Training Department, Samut Prakan, Thailand; TD/RP/183; 76 p
- SEAFDEC/TD. 2017. Report of the Workshop on Regional Cooperation for Implementation of Port State Measures to Improve Fisheries Management and Reduce IUU Fishing in Southeast Asia. Training Department, Southeast Asian Fisheries Development Center, Samut Pakan, Thailand; 117 p
- Yuttana Theparoonrat, Hajime Kawamura, Virgilia T. Sulit, and Nopporn Manajit. 2016. Strengthening Fishery Resource Rehabilitation Measures to Mitigate the Impacts of IUU Fishing. *In: Fish for the People Vol. 14 No. 2: 2016 (Special Issues)*. Southeast Asia Fisheries Development Center, Bangkok, Thailand; pp 63-75

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# Monitoring and Identification of Harmful Algal Blooms in Southeast Asia to Support SDG 14.1

Yeap Soon Eong and Virgilia T. Sulit

One of the targets of SDG 14 on conservation and sustainable use of oceans, seas and marine resources for sustainable development adopted in September 2015, indicates that (SDG 14.1): By 2025, “marine pollution of all kinds in particular from land-based activities, including marine debris and nutrient pollution, shall have been prevented and significantly reduced.” One of the UN indicators for achieving the said target is the “index of coastal eutrophication.” By definition, “eutrophication is the enrichment of water as a result of an increase in nutrients, especially nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life, which can have negative impact on the marine and coastal environment.”

The Singapore-based SEAFDEC Marine Fisheries Research Department (MFRD) has embarked on a Japanese Trust Fund Project on “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” which includes monitoring of biotoxin-producing harmful algal bloom (HAB) species, which ensures that fish and shellfish are not contaminated with these toxic algae or their toxins, and enhances regional capabilities in identifying biotoxin-producing HAB species. This is considering that in recent decades, many coastal countries in Southeast Asia have experienced an increasing trend in pollution-associated problems caused by massive blooms of harmful and toxic algae, known before as “red tide” and now better known as “harmful algal bloom” (HAB). The occurrence of HAB in fresh and marine waters has led to mass mortalities of wild and cultured fish and shellfish, human illnesses and to some extent, death from contaminated shellfish or fish, death of marine mammals, seabirds, and other animals, and alteration of marine habitats or trophic structure through shading, overgrowth, or adverse effects on life history stages of fish and other marine organisms, hampering the sustainability of fisheries and aquaculture.

## Common HAB species in the Southeast Asian region

Harmful Algal Bloom species (HABs) are overgrowths of algae in water, some of which produce dangerous toxins in fresh or marine waters as well as non-toxic blooms that harm the environment and national economies. HABs grow in waters with considerable amount of sunlight and are slow-moving with large amount of nutrients, especially nitrogen and phosphorous. Nutrient pollution from human activities makes the problem on HABs worse, as this could lead to much more severe blooms that occur more often. Many studies have

indicated that HABs can produce extremely dangerous toxins that can make not only people sick leading to deaths but also high mortalities in aquatic animals (GEOHAB, 2010). By creating dead zones in the water, the occurrence of HABs can lead to high treatment costs for drinking and clean water, damaging the industries that depend on clean water for their operations including the aquaculture industry.

The most common HABs in the ASEAN region include: *Cochlodinium polykrikoides* - a chain-forming dinoflagellate associated with massive fish kills; *Pyrodinium bahamense* var. *compressum* - chain-forming dinoflagellates that produce Paralytic Shellfish Poisoning (PSP) toxins; *Alexandrium* - another dinoflagellate genus which contains PSP toxin-producing species; *Prorocentrum minimum* - causes mass mortality of aquacultured fish in Japan, Philippines, and Singapore; *Karenia mikimotoi* - forms red tides in western Japan and in other waters in Southeast Asia; *Phaeocystis globosa* - a prymnesiophyte which occasionally causes extensive blooms, leading to fish kills and mortality of caged fish and lobsters in waters of China and Viet Nam; and *Noctiluca* - a monospecific genus of large unarmored heterotrophic dinoflagellates.

HABs can be broadly classified into two groups, namely: biotoxin producers which cause biotoxin contamination in fish and shellfish resulting in human illness and death when the fish and shellfish are consumed, such as PSP, Diarrhetic Shellfish Poisoning (DSP), Amnesic Shellfish Poisoning (ASP); and high-biomass producers which can increase cell populations in a short time and cause mass mortalities of fish and other marine life. Timely detection of HABs and the toxins produced is a critical component of most fish and shellfish safety management plans. Such information, if made available earlier in the process of toxic HAB initiation and development, can provide coastal resource managers, fishers, aquaculture operators, and public health officials with the data needed to recommend or take actions for mitigating the effects of toxic HABs. In addition to routine surveillance for biotoxins in fish and shellfish at import control as well as in wholesale and retail markets, monitoring of biotoxin-producing HABs is crucial to detect the presence of toxic algae or development of harmful blooms, and provide early warning to aquaculture operators and other concerned parties. Fast, early warning of increased toxic HAB cell numbers can help biotoxin monitoring programs in ensuring the safe harvest of fish and shellfish from toxin-free areas of the coasts, as well as redirecting resources to target more vulnerable locations.



Massive bloom of the algae *Noctiluca* spp.

The ecological and economic impacts of HABs in the Southeast Asian region are enormous and apparently increasing, especially that many ASEAN Member States (AMSs) generate the highest amount of production of cultured fish and shellfish in the world. Thus, the impacts from HABs on these resources in the region would be high. In addition, the Southeast Asian region has been characterized as having a high diversity of harmful syndromes and causative organisms; an apparent increasing trend of HABs throughout the region; and an increasing trend toward regional eutrophication.

The causes behind the increasing trend of HAB incidences are varied ranging from natural mechanisms of species dispersal to a host of human-related phenomena such as increasing nutrient-rich pollution, climate change, or transport of algal species via ship ballast water. Many countries are faced with a bewildering array of toxic or harmful species and impacts, as well as disturbing trends of increasing bloom incidence, more impacted resources, larger areas affected, and higher economic losses. It is with this backdrop that MFRD expanded its project on “Chemical and Drug Residues in Fish and Fish Products in Southeast Asia - Biotoxins Monitoring in the ASEAN Region” to include monitoring and identification of biotoxin-producing HABs.

## Enhancing Regional Capacity in Monitoring and Identifying Biotoxin-producing HABs

Marine biotoxins represent a significant and expanding threat to human health in many parts of the world. The impact is visible in terms of human poisoning or even death following consumption of contaminated shellfish or fish, as well as mass killings of fish and shellfish, and death of marine animals and birds. The Codex Alimentarius Code of Practice for Fish and Fishery Products (CAC/RCP 52-2003) defines biotoxins as 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. Therefore, monitoring seafood toxicity is essential to manage the risks. However, there are several limitations in monitoring for toxicity such as variations in toxin contents between individual shellfish; different detection and extraction methods for various toxins; decision needed on which toxins should be tested for; and frequency of sampling to ensure that toxicity does not rise to dangerous levels in temporal or spatial gap between sampling times or locations. Furthermore, the growing harvest of non-traditional shellfish (e.g. moon snails (Family: Naticidae), whelks (Family: Buccinidae), barnacles) could increase human health problems and management responsibilities.

The aforementioned five-year project of MFRD on biotoxins monitoring was initiated in 2009, primarily covering the DSP toxins, lipophilic toxins, PSP toxins, and Tetradoxin (TTX). Prior to the completion of the project in 2012, many AMSs identified other biotoxins that need to be dealt with, such as the ASP toxin (Domoic Acid), Azaspiracids (AZA), and Brevetoxins (BTX) which cause Neurotoxic Shellfish Poisoning (NSP). The AMSs also proposed to conduct monitoring survey on PSP toxins in the respective AMSs. Moreover, the AMSs also pointed at the importance of identifying toxic HABs to complement the existing biotoxins monitoring activities to ensure that fish and shellfish are not contaminated with toxic algae or their toxins. Thus, MFRD was specifically asked to enhance regional capabilities for the identification and monitoring of toxic HABs, as well as monitoring and testing of fish and shellfish. This MFRD project was therefore extended for another five years (2013-2017) to continue the monitoring of other biotoxins including biotoxin-producing HABs, in line with relevant provisions in the 2011 Resolution and Plan of Action (SEAFDEC, 2011) shown in **Box 1**.

### Box 1. Provisions in the 2011 Resolution and Plan of Action related to the MFRD project on “Chemical and Drug Residues in Fish and Fish Products in Southeast Asia - Biotoxins Monitoring in the ASEAN Region”

**Resolution 21:** Improve technologies and facilities to ensure fish quality assurance and safety management systems, taking into account the importance of traditional fishery products and food security requirements, and promote the development of fishery products as an alternative supplementary livelihood for fisheries communities.

**Plan of Action D61:** Strengthen fish quality and safety management systems that support the competitive position of ASEAN fish products on world markets, including moving towards ISO/IEC 17025 accreditation of national fish inspection laboratories, strengthening capacity and acknowledging the recognized national laboratories, risk analysis and equivalence agreement such as the Mutual Recognition Agreement (MRA) and promote the implementation of the quality and safety management systems among small and medium enterprises in the ASEAN region.

**Plan of Action D63:** Promote and conduct training programs and develop training materials to upgrade the technical skills and competencies of personnel in the public and private sectors on fisheries post-harvest technology and food safety management system.

## Management of HABs in the Southeast Asian Region

Under the framework of the project and with support from the Japanese Trust Fund, MFRD convened the “Regional Technical Consultation (RTC) on HABs in the ASEAN Region” in Singapore on 5-6 August 2015 for the AMSs to report on toxic HAB occurrences and incidences as well as

the management of toxic HABs in their respective waters, and to plan for the subsequent activities under the project. The RTC was attended by representatives from the AMSs and Japanese Experts on HABs, *Dr. Yasuwo Fukuyo* and *Dr. Hiroshi Oikawa*. The status of HABs monitoring and management as well as the constraints and future plans of the AMSs are shown in **Box 2** (MFRD, 2015).

### Box 2. HABs occurrences, management and future plans in the ASEAN Member States

Brunei Darussalam
<b>HABs Occurrences:</b> First recorded occurrence of red tide in country’s waters was in 1976
<b>Actions taken:</b> Routine was established to monitor red tide phenomenon that includes plankton monitoring and shellfish toxicity testing, to prevent or mitigate adverse impacts on humans and economic losses to the fishing industry
<b>Issues and Concerns:</b> Lack of experts and trained personnel on HAB management; involvement of multi-level agencies; difficulties in sampling at adequate temporal and spatial scales; lack of tracking method and modelling; lack of infrastructure, e.g. analytical facilities and monitoring tools; inadequate public outreach efforts and centralized database
<b>Future Plans:</b> Activate regularly the National Red Tide Action Plan established in 1992 to disseminate information to the public quickly and correctly in order to reduce impacts of red tide on public health and the fishing industry; promote massive information dissemination to increase public awareness; develop monitoring and identification technologies and strategies; enhance coordination with neighboring countries to disseminate early reports on occurrence of red tide in their respective waters
Cambodia
<b>HABs Occurrences:</b> Paralytic Shellfish Toxin (PST) was detected in brackish and freshwater puffer fish (April 2005-January 2006) using high performance liquid chromatography (HPLC) that caused deaths to consumers; Tetrodotoxin (TTX) was also detected in brackish and freshwater puffer fish (Tetraodontidae) and horseshoe crabs ( <i>Carcinoscorpius rotundicauda</i> ) from April 2005 to January 2006) using liquid chromatography-mass spectrometry (LC/MS)
<b>Actions taken:</b> Fish and green mussel specimens were sent to Viet Nam for analysis as there are no facilities for this purpose in the country
<b>Issues and Concerns:</b> National Laboratory could not analyze biotoxins; limited budget; collected data not sufficient to reflect the actual situation of biotoxins and HABs in cultured and wild fish in the country; no plans on monitoring of biotoxins and HABs
<b>Future Plans:</b> Training of laboratory staff to enhance their knowledge and skills on methods of analyzing biotoxins and HABs; support the promotion of Inter Laboratory Proficiency Testing for Biotoxins and Harmful Algal Blooms; support the establishment of networking system to develop the methods of analyzing biotoxins and HABs for the region
Indonesia
<b>HABs Occurrences:</b> Although data on food poisoning associated with biotoxin arises from consumption of seafood are rarely observed in the country, some cases were reported, such as: blooming of <i>Trichodesmium erythraeum</i> in Lampung and thousand islands reported in 1991 that caused mortalities in cultured shrimps; consumption of shellfish <i>Meritrix meritrix</i> caused human deaths in Makassar, South Sulawesi (1987) and Sebatik Islands, East Kalimantan (1988); deaths after consumption of ‘bia manis’ ( <i>Hiatula chinensis</i> ) was reported in Ambon in July 1994, the samples that were taken showed presence of <i>Pyrodinium bahamense</i> var. <i>compressum</i> (Pbc); blooming of <i>Pyrodinium bahamense</i> in Lampung in 2013 caused mortalities in cultured fish; blooming of phytoplankton in Jakarta Bay in 2004 caused massive fish kills
<b>Actions taken:</b> Implementation of Shellfish Monitoring Program since 2015; Monitoring of Ciguatoxin for coral fish since 2016; Monitoring of HABs since 2016
<b>Issues and Concerns:</b> Causes of such poisoning were unknown and problems caused by “red tide” were seldom serious or probably not reported due to: as an archipelago, Indonesia has a long coastline and 2/3 of the Indonesian zones are oceans, insufficient knowledge on the part of fishers, inadequate data and information although many institutions are dealing with biotoxins, lack of funds, lack of coastal resources management, lack of knowledge on biotoxins, lack of laboratory capacity to analyze biotoxins
<b>Future Plans:</b> Continue Shellfish Monitoring Program (started in 2015) in Ambon, Jakarta Bay, Lampung, East Java, Tanjung Balai; Continue monitoring of ASP, AZA and BTX: develop testing methods; Continue monitoring of Ciguatoxin for coral fish (started in 2016) in Lampung, Makassar, Bali, East Java, Papua, Gorontalo; Continue monitoring of HABs (started in 2016) in Ambon, Jakarta Bay, Lampung, East Java, Tanjung Balai
Lao PDR
<b>HABs Occurrences:</b> No data on occurrences and monitoring activities on HABs; no activities or training on HABs monitoring
<b>Actions taken:</b> Management system of HABs is undertaken by the Aquaculture Management Section of Namsouang Aquaculture Development Center
<b>Issues and Concerns:</b> No authority in charge on HABs monitoring; lack of specialists or experts on HABs; Laboratory for HABs analysis is not yet set up; Need financial and technical support to carry out the country’s future plans
<b>Future Plans:</b> Conduct research and related activities on HABs in freshwater bodies of the country; Capacity building on HABs such as training and monitoring activities; Cooperate on lab-testing of HABs with neighboring countries; Set up laboratory for HABs analysis

## Box 2. HABs occurrences, management and future plans in the ASEAN Member States (Cont'd)

### Malaysia

**HABs Occurrences:** West coast of Sabah (1976): 202 people were intoxicated and there were 7 deaths due to *Pyrodinium bahamense* var. *compressum*; Johore Strait (1985): heavy shrimp kills due to *Chattonella marina*; Sebatu, Malacca (1991): shellfish contamination and 3 people were hospitalized due to *Alexandrium tamiyavanichi*; Johore Bharu, Johore (2002): water discoloration due to *Prorocentrum minimum*; West Coast of Sabah (2004): massive fish kills in cages and shellfish contaminated with *P. bahamense* var. *compressum* and *Cochlodinium polykrioides*; Off-shore Miri (2004): localized warning but no impact due to *C. polykrioides*; West Coast of Sabah (2005): massive fish kills in cages due *P. bahamense* var. *compressum* and *C. polykrioides*; Lawas, Limbang (2005): localized warning but no impact due to *P. bahamense* var. *compressum* and *C. polykrioides*; Pangkor, Lumut, Penang (2007): water discoloration due to *Ceratium furca*; West Coast of Sabah (2009): shellfish contamination due to *P. bahamense* var. *compressum*; Kuantan, Pahang (2013): shellfish contamination and 2 were hospitalized due to *P. bahamense* var. *compressum*; West Coast of Sabah (2013): more than 40 people were intoxicated and there were 3 deaths due to *P. bahamense* var. *compressum* and *C. polykrioides*; Lawas (2013): localized warning but no impact due to *C. polykrioides*; Kuantan, Pahang (2014): fish kills in cages due to *P. bahamense* var. *compressum*; Johore Strait (2014): massive fish kills due to *Karlodinium austral*; West Coast of Sabah (2014): fish kills in cages and shellfish contamination due to *P. bahamense* var. *compressum* and *C. polykrioides*; Johore Strait (2015): massive fish kills due to *K. austral*; West Coast of Sabah (2015): fish kills in cages due to *C. polykrioides* and *Notiluca scintillans*

**Actions taken:** Regular and constant monitoring since 1976; Results for over 20 years indicated that PSP levels widely varied for different periods, locations, and species; intensify public warning through localized warning intended only for affected district and PSP level exceeding the danger limit (400 MU), and Statewide warning issued through press releases, radio and TV broadcasts when HAB outbreaks widely spread and the PSP level exceeds the danger level in all high risk areas in each affected State; Public Education through distribution of “easy-to-understand” leaflets on guidelines and precautions to be taken during PSP outbreaks to the fishing community and general public; HAB awareness campaign-cum-exhibition during state festivities; Public HAB forum with local communities, students

**Issues and Concerns:** Lack of long term scientific knowledge on biology, taxonomy, eco-physiology, mechanism of blooms and toxin chemistry of HABs; Insufficient comprehensive and cost-effective monitoring programs and techniques country-wide to provide early warnings to prevent human intoxication, massive fish kills and economic losses to the fishery industries; Inadequate mitigation measures to minimize impacts and economy losses to the fishery industries; Lack of strategic plan to educate and promote public awareness in targeting all level of communities in the affected areas; Insufficient funding to strengthen laboratory facilities to conduct internationally recognized techniques with trained, dedicated and responsible manpower in monitoring and analysis activities; Inadequate enforcement during occurrence of HABs to prevent selling of contaminated fishery products that cause harm to the consumers; Lack of structured training and capacity building programs on HABs and biotoxins for personnel of national competent authority

**Future Plans:** Recent occurrences of HABs in the country that caused human intoxications and massive fish kills need to be addressed seriously to safeguard consumers on seafood safety and minimize economic losses of fishery industries; Department of Fisheries Malaysia to continue making efforts to address issues and challenges pertaining to HABs and biotoxins in the country, with cooperation among relevant government agencies, research institutions, universities and international organizations, to achieve systematic and consistent management of HABs in the near future; To continue management of biotoxins by identifying and focusing on biotoxins of high priority, especially those having significant impacts on human and animal health and the health of ecosystems, harmonizing and standardizing analytical methods that are internationally validated with standard operation procedures (SOPs) for all the diagnostic laboratories for each individual aquatic biotoxin, identifying the most appropriate analytical instruments for each individual aquatic biotoxin of high priority, assessing the capabilities and facilities of the existing diagnostic laboratories for further enhancement and improvement, establishing toxin standard development, maintenance, and distribution system, so that these toxins are equally accessible and available to all diagnostic and research laboratories, conducting training programs to increase human resource capabilities to produce experience and skillful laboratory analysts in public and private laboratories, effectively coordinating the resources and facilities that are currently in government agencies, research institutions and universities, developing rapid (e.g. in situ detection) and cost-effective methods for detecting and quantifying biotoxins that are accepted internationally

### Myanmar

**HABs Occurrences:** No data

**Actions taken:** Survey of molluscan shellfish conducted in 2015 for *Crassostrea belcheri* (oyster) and for *Perna viridis* (green mussel) which started recently

**Issues and Concerns:** Project funding is very limited and not sufficient for over all survey expenses; at present, the enzyme-linked immunosorbent assay (ELISA) method of biotoxins analysis is used to analyze the survey results because LC/MS/MS is more expensive than the ELISA method

**Future Plans:** Enhance knowledge and awareness of Myanmar people on biotoxins; Minimize biotoxin incidents on seafood consumers; Control biotoxin outbreaks by implementing surveillance monitoring program; Improve capacity of human resources and skilled laboratory staff for biotoxins analysis; Comply with uniform objective of biotoxins monitoring in all AMSs; Upgrade laboratory capabilities for testing biotoxins in fish and fishery products; Establish national Biotoxins Monitoring Programs for ASP, AZA, DSP, and BTX; Improve knowledge and understanding of the levels of biotoxin occurrences and incidences in fish and fishery products of the country and ensure that fish products are safe from biotoxin contaminations

### Philippines

**HABs Occurrences:** June 1983 - 1<sup>st</sup> recorded occurrence of *Pyrodinium bahamense* var. *compressum* (Pbc) in Samar; 1987 - Pbc observed in coastal waters of Zambales and Western Samar; Succeeding years - Pbc blooms sighted in Manila Bay and in different coastal waters in the Visayas region; 1990s - spread of Pbc bloom in most coastal waters of the Philippines was observed; 2003 - *Alexandrium minutum* was first recorded in coastal waters of Bolinao, Pangasinan; 2006-2007- Pbc blooms were reported only in Sorsogon Bay and Juag Lagoon, Matnog in Sorsogon Province

## Box 2. HABs occurrences, management and future plans in the ASEAN Member States (Cont'd)

**Actions taken:** 1984 - the Philippines initiated a monitoring program for all red tide affected areas to detect the bloom at its early stage; 1987 - Bureau of Fisheries and Aquatic Resources (BFAR) conducted national training courses on red tide detection, identification and monitoring to give timely alert and response to the public at local level should a threat of Pbc bloom become imminent; 1988 - due to the considerable negative impacts of Pbc blooms, the National Red Tide Task Force (NRTTF) was created as one of the task forces of the Inter-Agency Committee on Environmental Health (IACEH). The main task of NRTTF is to come up with monitoring and management schemes. Policies made by the NRTTF were published in the Philippine Guidebook on Toxic Red Tide Management, where the monitoring and management strategies in the guidebook serve as guide for red tide managers both in the local and national levels; 1989 - PSP Monitoring started as a project of BFAR and subsequently adapted as a national program; 1990 - the Local Red Tide Task Force was established as PSP problems expanded geographically; 1999 to 2001 -BFAR-JICA Technical Cooperative Project was implemented; 2005 - BFAR took over the monitoring program in accordance with **Republic Act (RA) 8550**; PSP management has since then been jointly conducted by BFAR and concerned local government units (LGUs); BFAR regularly releases shellfish advisories countrywide through its regional offices and the LGUs, based on the results of analysis of the Marine Biotoxin Laboratory and those from other red tide laboratories managed by the different LGUs; BFAR releases shellfish bulletins regularly every two weeks and whenever necessary

**Issues and Concerns:** Frequency of plankton blooms has increased nationwide; Undetermined causes of country-wide expansion of toxin-producing planktons considering that HABs did not occur when investigations were carried out by transplanting infected shellfish seeds in non-infected areas

**Future Plans:** Continue the Marine Biotoxin Monitoring Program through improved analysis for okadaic acid (OA) toxins, Dinophysistoxin (DTX) and Ciguatera Fish Poisoning (CFP) toxin, Use of screening techniques for PSP, ASP and DSP detection in the laboratories at regional and local levels, Adoption of the Association of Official Analytical Chemists (AOAC) Accredited Isotope-Based Receptor Assay for PSP, Establishment of baseline data for PbTX and AZP

### Singapore

**HABs Occurrences:** Recent incidences occurred in 2009, 2014 and 2015 that led to mortalities in farmed and wild fish; in the 2015 incident, fish loss was estimated at 500-600 metric tons; water discoloration (brown) was observed at farming areas; the main plankton species was *Karlodinium veneficum* that caused damage to fish gills resulting in death of the cultured fish

**Actions taken:** The Tropical Marine Science Institute (TMSI) of the National University of Singapore is among the leading experts in the field of phytoplankton studies, and is engaged in the current research on biology and toxicology of HAB species. During HAB events, the Agri-Food & Veterinary Authority of Singapore (AVA) works closely with TMSI to identify the causative plankton species. Fish farmers on their part, reduce the impacts of plankton bloom through the use of canvas and closed containment or transfer fish stocks to non-affected areas, and in some cases emergency harvesting is made after the AVA tested that fish is safe for consumption. AVA also assists affected farms by providing technical advisory on mitigation measures, monitoring water quality and providing SMS alerts to farmers; providing dead fish disposal services; and facilitating transfer of fish stocks to unaffected areas; and assisting in emergency harvest and liaising with cold storage owners

**Issues and Concerns:** Frequency of blooms associated with fish mortality has increased; Complex blooms consist of multiple plankton species; What Can Be Done to Minimize impacts - require faster detection, more scientific information on species and detailed study of toxins, and possible control and prevention measures

**Future Plans:** Understanding the cause(s) of plankton blooms through conducting studies on plankton blooms and hydrodynamic modeling, continued consultations with experts; New technologies to reduce impact of future blooms through development of Closed Containment Aquaculture System, and technology providers to provide effective counter-measures; Assistance to farmers to build resilience against future blooms for farms to develop an operationally ready farm contingency plan, and adopt new farming technologies that can reduce impact of blooms

### Thailand

**HABs Occurrences:** 1957s to 2007s - occurrence of dominant species *Noctiluca scintillans* (non-toxic producing phytoplankton); May 1983 in Pranburi River, Prachuap Kirikhan Province, where there were 63 victims from eating mussels

**Actions taken:** Field survey conducted in 1984 in Pranburi for PSP causative organism; abundance of phytoplankton monitored in the Gulf of Thailand and Andaman Sea; training courses on monitoring toxins in phytoplankton and bivalves have been conducted

**Issues and Concerns:** Need to control sources of pollution from the land along the coast, due to increased development and utilization of coastal areas; reduce and control discharge of sewage including organic contents of nutrients and sediments because bacterial contamination of the sea increases during expansion of the communities and industry; develop strict control measures and law enforcement of the relevant government agencies; integrate agencies involved in water quality management

**Future Plans:** Join the proficiency test of phytoplankton with Bequalm Marine Institute in Copenhagen, Denmark

### Viet Nam

**HABs Occurrences:** Red tide phenomenon occurs mainly in the central coast areas rather than in the Gulf of Tonkin and in the southern part of the country; in May 1995 algal bloom *Noctiluca scintillans* occurred in Van Phong Bay of Khanh Hoa Province causing mortalities to about 20 metric tons of lobster and losses of VND 6 billion; Disaster "red tides" in Binh Thuan in mid-September 2002: red tide occupied wide area of over 40 km<sup>2</sup> killing about 90% aquatic animals living in tidal areas, including fish and shrimps in cages; Red tide caused hospitalization of 82 people after swimming in affected sea that resulted in itching and blistering of sensitive areas; Based on statistical data from 1999 to 2007 in Binh Thuan Sea, red tide phenomenon often occurs with increasing frequency: once in March 1999, July 2002, July 2004; twice in August 2005, July and September 2007. During July 2011 - August 2012, five harmful algal events occurred in Ha Long Bay causing losses of \$US3.0-5.0 million for local fisheries.

## Box 2. HABs occurrences, management and future plans in the ASEAN Member States (Cont'd)

**Actions taken:** National Monitoring Program for Bivalve Mollusk Production Areas was established and implemented since 1999 covering 20 bivalve and mollusk production areas in 12 cities and provinces: Ho Chi Minh City, Tien Giang, Ben Tre, Tra Vinh, Kien Giang, Binh Thuan, Ha Tinh, Thanh Hoa, Ninh Binh, Thai Binh, Nam Dinh and Quang Ninh. Species monitored include: *Meretrix lyrata*; *Paphia* sp.; *Tegillarca granosa*; *Anadara subcrenata*; *Anadara antiquata*, *Chlamys nobilis*; *Lutraria philippinarum*; *Crassostrea gigas*, parameters collected include microorganisms, toxic algae, marine biotoxins, heavy metals, organochlorinate pesticides

**Issues and Concerns:** The National Monitoring Program for Bivalve Mollusk Production Areas is currently focusing on supervision of the fluctuations of toxic algae species in some areas (mainly harvesting of bivalve mollusks), not monitoring all the harmful algal species, especially that algae that often cause HAB in all coastal areas of the country; Still using traditional methods for analysis of toxic algae in the National Monitoring Program, in which using a microscope requires complex, takes time to process (sampling, storage, transportation and must analyze in the laboratory), depends on analyst and chemical usage; no comprehensive national monitoring program on harmful algae phenomenon for early warning of HABs occurrence, although many scientists as well as several projects of the country are engaged in researches on HABs and toxin-producing HABs; Research on HABs is mainly carried out by scientists from research institutes (e.g. Institute of Oceanography, Marine Research Institutes) and results of their studies are published in scientific journals or newspapers, but are seldom disseminated to other people, especially the fishers, who are not aware of HABs and the necessary measures to be taken when HABs occur

**Future Plans:** Establish a national monitoring program for all harmful algal species in coastal waters as it is essential for early warning of HABs occurrence; Conduct of training for people, particularly the fishers to increase their understanding of HABs and the measures to be undertaken during occurrence of HABs; Set up advanced methods and equipment for quantitative analysis of harmful algae, e.g. portable equipment for quick testing in the field; online quantitative monitoring of algae to measure and monitor the algae with different levels of warning on HABs occurrence

## HABs Occurrences and Management in Japan

In Japan, the major toxic HAB species are *Alexandrium tamense*, *A. catenella*, *A. tamiyavanichii*, *Gymnodinium catenatum*, *A. ostenfeldii* that cause PSP; *Dinophysis fortii*, *D. acuminata* that could lead to DSP; *Gambierdiscus toxicus* that causes ciguatera fish poisoning (CFP); and *Ostreopsis* spp. that causes Palytoxin-like fish poisoning. While causative dinoflagellates are regularly monitored, distribution of high-risk fishes is prohibited as an immediate measure. No incidences of neurotoxic shellfish poisoning, amnesic shellfish poisoning, and azaspiracid shellfish poisoning had been reported in Japan (Oikawa, 2015).

### Monitoring System of PSP and DSP in Japan

The monitoring system for PSP and DSP in Japan includes HAB monitoring, bivalve monitoring and sampling inspection.



**Toxic HAB monitoring:** Cell count by research department in a local government (microscopy) is carried out, after which prediction of contamination of bivalves with PSP and DSP toxins is established.



**Bivalve monitoring:** Toxicity assay by local government and/or fishermen (mouse bioassay) is carried out and voluntary controls are promoted to prevent toxic shellfish from being shipped to the market.



**Sampling inspection:** Toxicity assay is undertaken by local government (mouse bioassay) and control is enforced by Food Hygiene Law in the market.



Local government is responsible for the monitoring and inspection activities. Some local governments also set the reference cell density for toxic HABs, and for such reason, the reference cell density varies among species.

### Monitoring of Toxic HABs in Osaka Bay

The local government conducts sampling for density of *A. tamarensis* once a week from February to May, in at most 20 sampling sites. If density of *A. tamarensis* is greater than 5 cells/ml, caution of toxic HABs is issued; if density of *A. tamarensis* is greater than 10 cells/ml, warning of shellfish

toxin is issued and shellfish from the area is surveyed; if density is greater than 4 MU/g\* (= 80 µg STX /100 g) - the regulatory limit for PSP in Japan, the fishing area is closed. The information is then relayed to fishers through the local government office on the same day and to the public through website by the next day.

### Red Tide Events in Japan

In 2013, about 262 red tide cases were reported of which 27 caused damages on the fisheries due to fish kill. The major toxin species that caused fish kill in Japan are: *Chattonella* spp., *Karenia mikimotoi*, *Heterocapsa circularisquama*, *Cochlodinium polykrikoides*, and *Heterosigma akashiwo*.

The local government and fishers through fishermen’s cooperatives are responsible for on-site monitoring of red tide events in Japan. The information from such monitoring across the country is summarized by Fisheries Agency of Japan. Training courses for HABs monitoring supported by Fisheries Agency of Japan are also conducted every year at the National Research Institute of Fisheries and Environment of Inland Sea of the Fisheries Research Agency (FRA) of Japan. The course contents include lectures on toxic HABs, fish kill due to HABs and their cysts; microscopic observation

of major HAB species in Japan; and identification techniques or morphological and molecular biological methods.

### Capacity Building on HABs Identification and Monitoring

Taking into consideration the need for capacity building as one of the major concerns raised by the AMSs, MFRD organized the “Regional Training Course on Identification of HAB Species in the ASEAN Region” on 18-22 July 2016 in Singapore in collaboration with the Intergovernmental Oceanographic Commission-Sub-committee for the Western Pacific (IOC-WESTPAC). Besides obtaining knowledge on identification of HAB species through lecture and practical sessions as well as field trips and sampling sessions, a team headed by the Philippines and consisting of a representative from each AMS was formed to prepare posters on red tide causing species and HAB species. The AMSs would provide relevant photographs of the species for the posters which will be distributed to the Southeast Asian region for knowledge sharing. After the training course, the AMSs are expected to establish appropriate methodologies in their respective laboratories for identifying toxic HABs. The participants also highlighted the need to enhance their knowledge and skills on specimen preservation and culture techniques of HABs. In this connection, MFRD would organize the Regional Training Course on Specimen Preservation and its Application in HAB Monitoring and Studies to enhance the capabilities of the AMSs in managing toxic HAB incidences. The said training course would include topics on specimen preservation methods and techniques, use of fluorescence and electron microscopy and flowcytometry. Moreover, another Regional Training Course on Culturing HAB Species, Identification and Toxin Characterization will also be conducted by MFRD under the framework of the project, to include topics on isolation, culturing and cell harvesting methods and techniques for morphology, molecular and toxin characterization of HAB species.

### Way Forward

As part of the project’s framework, “Biotoxins Monitoring Surveys” have been carried out in the AMSs starting 2015 until 2017. Results of the countries’ surveys would be published as a Technical Compilation in 2019. The Technical Compilation would comprise biotoxins analytical methods and biotoxins monitoring survey reports of the AMSs, the methodologies for the isolation, culturing, preservation, identification and monitoring of toxic HAB species, country reports on toxic HAB occurrences and incidences as well as the management of toxic HABs in the AMSs, and a directory of responsible national authorities and HAB experts in the AMSs. This is intended to increase the awareness of stakeholders on



Photos by Fisheries Research Division, Oita Prefectural Agriculture, Forestry and Fisheries Research Center



Regional Technical Consultation on HABs in the ASEAN Region, Singapore, 5-6 August 2015, also served as a forum for compiling information from the ASEAN Member States on toxic HABs occurrences and incidences as well as the management of toxic HABs in the region, to be included in the Technical Compilation to be published in 2019



One of the capacity building activities on HABs was the Regional Training Course on Identification of HAB Species in the ASEAN Region organized by MFRD on 18-22 July 2016 in Singapore

mitigating the impacts of HABs on public health, well-being of aquatic animals, and the environment.

Specifically, the outputs of this MFRD project would include enhanced capabilities of the AMSs in monitoring, identifying and management of HABs; and continued cooperation among the AMSs in information dissemination, especially in providing early warning of the occurrence of HABs in the AMSs. Finally, it is expected that the outputs of this project would contribute to the realization of SDG 14.1, mainly in reducing marine pollution in order that the level of coastal eutrophication in the Southeast Asian region is reduced to the barest minimum.

## References

- GEOHAB 2010. Global Ecology and Oceanography of Harmful Algal Blooms, Harmful Algal Blooms in Asia. K. Furuya, P.M. Glibert, M. Zhou and R. Raine (eds.), IOC and SCOR, Paris and Newark, Delaware. 68 p
- SEAFDEC. 2011. ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 23 p
- MFRD. 2015. Report of the Regional Technical Consultation (RTC) on HABs in the ASEAN Region, Singapore, 5-6 August 2015. Marine Fisheries Research Department of the Southeast Asian Fisheries Development Center; in press
- Hiroshi Oikawa. 2015. Current situation of HAB Occurrences and Monitoring Programs in Japan. Paper presented during the Regional Technical Consultation (RTC) on HABs in the ASEAN Region, Singapore, 5-6 August 2015. Marine Fisheries Research Department of the Southeast Asian Fisheries Development Center; in press

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# Development of a Sustainable Mangrove Crab Industry through Science-Based Research

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Farming of mangrove crab (or mud crab) species, e.g. *Scylla serrata*, *S. tranquebarica* and *S. olivacea* has long been established in the Philippines although the preferred species for growing is *S. serrata*. The Philippines' total production of mangrove crab from aquaculture in 2013 was estimated at 16,160 metric tons valued at PhP 5.2 billion, making the country the second top producer of mangrove crab in the world (FAO, 2015). The sources of crab seeds for farming are from the wild and in recent years, a small percentage from hatcheries. Degradation of the natural habitat and uncontrolled collection of all sizes of crabs have resulted in the depletion of the natural population of mangrove crab. As a stopgap measure, the Bureau of Fisheries and Aquatic Resources (BFAR) together with the provincial and municipal government issued ordinances that prohibit the gathering and selling of crablets ( $\leq 3$  cm) outside the municipality of origin to reduce not only the volume of harvest from the natural habitat but also the collection and trading of ovigerous (berried) females. This has resulted to increased acceptability of hatchery-reared crab juveniles by crab growers. Through the R&D efforts of the Philippine-based SEAFDEC Aquaculture Department, dissemination of sustainable management of mangrove crab culture to the region has been intensified for a sustainable mangrove crab industry in Southeast Asia.

## Intensifying Research on Sustainable Mangrove Crab Production

The SEAFDEC Aquaculture Department (AQD) has been conducting studies on mangrove crab seed production since 1977 but was discontinued due to focus of studies on other priority crustaceans such as *Penaeus monodon*. Studies were later reactivated in 1997 when the Australian Centre for International Agricultural Research (ACIAR) provided funds to AQD for the conduct of studies that mainly focused on the development of seed production and improved farming techniques. Later in 2002, the European Union also provided funds for AQD to implement a four-year collaborative project on the culture and management of *Scylla* species. With involvement of the University of Wales in Bangor, United Kingdom; University of Ghent, Belgium; and Can Tho University, Viet Nam, the AQD collaborative project was aimed at improving the reliability and economic viability of mangrove crab hatchery and nursery production for mangrove-pond aquasilviculture systems and stock enhancement. Moreover, the Government of Japan through its Japanese Trust Fund also partially funded a four-year study on the domestication of mangrove crab starting 2007.

With such outpouring support, AQD was able to carry out refinements on the grow-out phase of mangrove crab culture starting in 1981, including the establishment of various stocking densities and feeding schemes, and development of culture management schemes in succeeding years. In 1995, AQD initiated studies on crab culture in mangrove pens in Panay Island in the Philippines, which were followed by trials on crab monoculture in tidal flats and estuaries with existing mangroves which were verified in various places in the country together with efforts that aim to enhance the adoption of crab culture technologies in coastal communities.

The approach used was based on the framework under the Institutional Capacity Development on Sustainable Aquaculture of AQD where science-based technologies are disseminated to coastal communities, Local Government Units (LGUs) and other stakeholders. As a result of such development, AQD attained advancements in mangrove crab culture (**Box 1**) that had been disseminated to the Southeast Asian region through capacity building and massive information dissemination.

Series of activities in the production of soft-shell mangrove crabs using hatchery-produced seeds is shown in **Box 2**. This scheme is being promoted by AQD not only in the Philippines but also in the whole Southeast Asian region.

## Addressing Issues and Concerns in the Mangrove Crab Industry

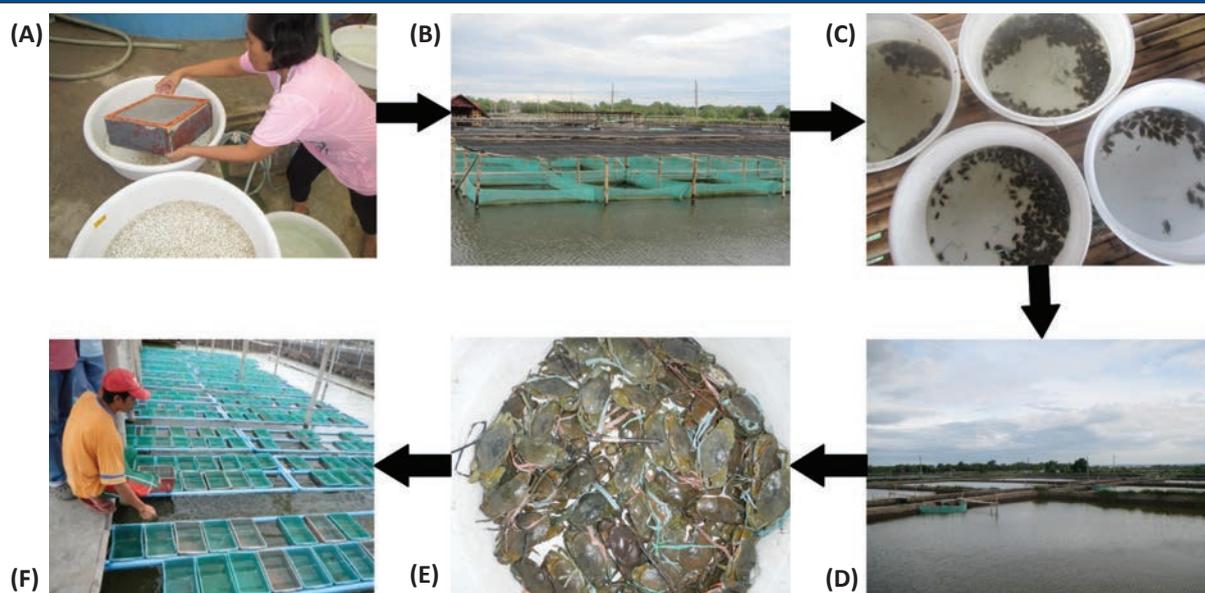
Although basic technologies had been developed for all phases of culture, e.g. hatchery, nursery, grow-out, fattening and soft shell crab production, studies have been conducted by AQD to continuously refine the techniques in order to improve the economic viability of producing crablets and adult crabs. Moreover, major issues that impede the sustainable development of mangrove crab industry are also being addressed. These include lack of seedstock, cannibalism particularly at the nursery phase, use of fish as aquafeed, difficulty of zoea V to molt to megalopa stage (Molt Death Syndrome or MDS), and diseases (bacterial and fungal infection, protozoan infestation in eggs and larvae, and White Spot Syndrome Virus or WSSV in sub-adult and adult crabs in ponds).

In an effort to address concerns as well as the various issues facing the industry, the Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development (PCAARRD) of the Philippine Department of Science and

### Box 1. Advances attained by AQD's R&D on mangrove crab

- Completion of life cycle of mangrove crab species
- Genetic structure and domestication of *S. serrata*
- Comparison of lipids in wild and pond-reared broodstock
- Assessment of reproductive performance in broodstock fed formulated feeds and/or natural food
- Identification of ovarian and embryonic development of *Scylla* spp.
- Development of hatchery technology and pilot testing of hatchery operation
- Determination of digestive enzyme dynamics during early larval stages
- Determination of feeding apparatus and foregut of larval stages
- Determination of feeding levels using natural food during larval stages
- Determination of use of formalin as prophylaxis
- Determination of acute toxicity of nitrite to crab larvae
- Salinity requirements for larvae and crab instars
- Development of nursery technology (Phases 1 and 2)
- Reduction of cannibalism using various strategies such as trimming of claws during intermolt and postmolt, manipulating density, and using various shelters in the hatchery
- Agonistic behavior of crabs
- Dietary tryptophan to reduce aggressiveness of juvenile crabs
- Apparent digestibility of feedstuff by mangrove crab
- Identification of dietary protein and lipid levels and protein to energy ratios
- Development of formulated diets (FD) for the various life stages (broodstock, larvae, juveniles, and subadults) and various feeding schemes using FD and natural food
- Identification of diseases in the hatchery and grow-out culture
- Monosex vs. mixed sex culture of mangrove crabs in pond grow-out
- Development of aquasilviculture using formulated diets
- Stock assessment of mangrove crab species in selected sites
- Behavioral studies prior to release in the estuaries
- Release and retrieval methods in stock enhancement

Box 2. Production of 60-100 g *Scylla* spp. juveniles: hatchery-produced crab instar (A) are cultured in nursery net cages for 3-4 weeks (B) then transferred to nursery ponds and grown for 4 weeks to crablet size (C). The crablets are cultured in bigger pond compartments (D) for 1.5-2.0 months to obtain 60-100 g (E) for stocking in soft-shell crab facility (F)



Deformed abdominal flap in juvenile crabs, one of the common abnormalities, when exposed to high levels of antibiotics during the larval phase

Technology (DOST) launched the National Mud Crab Science and Technology Program (NMCSTP) in 2012 that initially included 14 projects aimed at improving the production, profitability and sustainability of mangrove crab culture. Specifically, the NMCSTP aims to reduce the dependence on the supply of wild caught crabs by accelerating the transfer of improved technologies on hatchery, nursery and grow-out culture to stakeholders; and increase production and maintain or improve the country's status as the second largest producer of mangrove crab in the world.

Later, five (5) more projects were undertaken to address the issues on identification of mangrove crab species (especially during the younger juvenile stage), traceability, disease prevention, and muscle emaciation, weight loss, ammoniacal odor, and other factors associated with storage and transport that could lead to lower market value.

Applications of genomics in mangrove crab aquaculture and resource management (stock delineation, molting, etc.) have also been included. The various projects under NMCSTP are being undertaken by AQD, University of the Philippines (Visayas and Diliman) and De La Salle University (Manila).

A summary of results from recent research studies on mangrove crab done by various researchers and scientists in the Philippines is shown in **Box 3**.

## Capacity Building

Another very significant activity of AQD is building the capacity of various sectors on the various technologies developed. Under the NMCSTP as in other AQD programs, improved technologies for all aspects of mangrove crab culture have been disseminated to the private sector, Non-government Organizations (NGOs), State Universities and

### Box 3. Results of research studies on mangrove crab conducted in the Philippines

#### Broodstock Management and Seed Production

- Completed life cycle of mangrove annelids (*Marphysa mossambica*) ( $F_2$ ) resulting to mass production of pathogen-free annelids
- Improved production of good quality larvae using *M. mossambica* as live food and feed ingredient for crab broodstock
- Criteria developed for selection of good quality newly hatched larvae for rearing using formalin stress test
- Natural food reduced by 50% with the use of formulated diets for larval rearing
- Refined feeding and water management reduced MDS resulting to improved survival rate of megalopa/crab instar from 3% to 22%
- Identified application of antibiotics during larval stage as one of the causes of morphological deformities in juveniles

#### Nursery Phase

- Attained higher survival of 70% in Phase 1 and 70-90% in Phase 2
- Identified net shelters simulating sea grasses as most suitable for nursery, 60-70% SR even at higher density of 50 ind/m<sup>2</sup>
- Feeding 30 mussel: 70 formulated basal diet sufficient to support good growth, survival and profitability
- Tryptophan in the diet not necessary in nursery rearing in ponds
- Attained better FCR and profitability in the nursery when feeding rations of either 100 initial body weight for the entire 3 weeks, or weekly adjustment of 100-50 -40 % of body weight for weeks 1,2,3, respectively for Phase 1; and weekly adjustment of 40-30-20% for Phase 2
- Established procedure for nursery phase to produce 60-100 g hatchery-reared juveniles for soft-shell crab farming in ponds
- Adopted soft-shell crab technology using hatchery-produced juveniles

#### Grow-out Phase

- Basal diet and improved formulated diet identified for mangrove crab
- Identified suitable binder that allows feeds to be stable in water in  $\geq 5$  h
- Assessed feeding behavior of crab: consumption and preference (e.g. semi-moist with different shapes and sizes) of different sizes of crabs
- Improved crab feed developed for commercial production
- Feeding strategies determined (frequency of feeding, amount, etc.)

#### Diseases

- Developed immunostimulant (polysaccharides from brown and green algae) for improving growth, survival, immunity and disease resistance of crabs
- Identified commercially available immunostimulants for crabs
- Identified two antimicrobial extracts effective against *V. harveyi* *in vitro* and *in vivo* tests
- Determined extracts to be non-toxic at 0.5-4 mg/ml
- Identified non-pathogenic probiont to all crab stages
- Evaluated farming practices and updated list of known diseases and other abnormalities in monoculture, polyculture and aquasiviculture systems
- Identified risk factors during culture

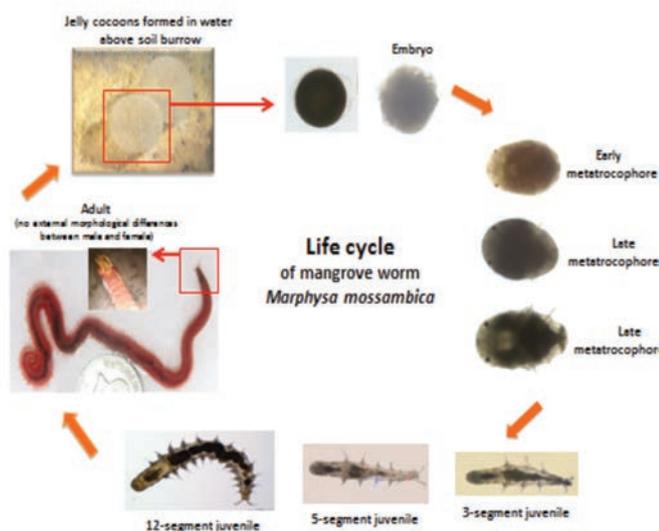
#### Feeds and Feeding

- Identified spherical or tubular as best form for formulated diet for juveniles
- Identified synthetic binders as more effective than natural feed binders in making pellets stable in the water up to 24 h.
- Developed SEAFDEC/DOST-PCAARRD grow-out diet for commercial production

#### Others

- Determined/developed applications of genomics on mangrove crab (maps, apps, molting and intermediate phenotype)
- Determined physiological responses of mangrove crab juveniles from coast of Bataan, Philippines to mercury/heavy metal levels

Colleges (SUCs), government agencies and LGUs through collaborations, regular training programs at AQD or on-site, conferences, workshops and publications. A number of private crab hatcheries had been established in the country through the NMCST under the guidance of AQD. A prototype demo-hatchery showcasing improved hatchery protocols was set up in Guindulman, Bohol. This demo hatchery is capable of producing 40,000 crab instars and was turned over to the Bohol LGU in May 2015.



Complete life cycle of mangrove worm *Marphysa mossambica*, used as mangrove crab feed (Adapted from VR Alava, 2007)

Furthermore, the Philippine Government also provides capacity building to various sectors on the different phases of mangrove crab culture. The various collaborations and the continuous activity on crab culture enabled AQD to package crab technologies, conduct local and international training courses and on-site technology demonstrations, and publish extension manuals and scientific publications since the mid 1990s. On-site training courses on mangrove crab culture had been conducted for members of LGUs, People's Organizations and coastal communities in the country, as well as in other countries such as in Brunei Darussalam, Myanmar, Timor Leste, India, and Bangladesh. A number of stakeholders from the private sector are now engaged in crab seed production.

Most of the hatchery operators that are into crab seed production are also engaged in marine fish seed production with an established rotifer production system. Rotifer is the major food item for the early larval stage of mangrove crab. Other hatchery operators have modified their shrimp hatchery facilities for crab seed production. To impart the recent technologies and developments in crab culture, a National Mud Crab Congress was organized by AQD, University of the Philippines-Visayas and PCAARRD-DOST. Funded by PCAARRD-DOST, the Congress brought together scientists, industry practitioners and stakeholders, government, and the academe from various parts of the Philippines. Recent developments related to culture or husbandry, diseases,



Net shelters simulating sea grasses are most suitable for nursery rearing of mud crab

resource enhancement and management, sustainable aquaculture and post-harvest of mangrove crabs were shared with the participants. Relevant issues and problem areas surfaced during the workshop and recommendations to address these were put forward for further research. Thus, the R&D on mangrove crab had been translated into improved production. With the developments and refinements of technologies, it is expected that the Philippines will increase its production by 25-50%. Other Southeast Asian countries could also follow suit in the future.



International trainees at AQD's Mud Crab Training identifying the ovarian maturation of crabs (*top*), and on-site trainees supervised by AQD Scientist in the construction of bamboo cage for fattening of crabs in Timor Leste (*above*)

## Philippine National Standard (PNS) for Live Mangrove Crabs

The Bureau of Agriculture and Fisheries Standards (BAFS) of the Philippine Department of Agriculture (DA) in collaboration with government and research agencies, academe and industry practitioners developed the Philippine National Standards (PNS) for live mangrove crabs. PNS determines the food safety and quality requirements for live mangrove crabs to ensure health and safety of consumers and make the product globally competitive. After several deliberations, the PNS for live mangrove crab was finalized and approved by the DA Secretary in 2016. The World Trade Organization has also been notified of the PNS which is also applicable to mangrove crabs coming into the country, if any.

### References:

- Alava, V.R., E.T. Qunitio, J. de Pedro, Z. Orosco and M. Wille. 2007. Reproductive performance, lipids and fatty acids of mud crabs *Scylla serrata* (Forsskal) fed dietary lipid levels. *Aquaculture Research* 38:1442-1451
- Alava, V.R., E.T. Qunitio, J.B. de Pedro, F.M. Priolo, Z. Orosco and M. Wille. 2007. Lipids and fatty acids in wild and pond-reared mud crab *Scylla serrata* (Forsskal) during ovarian maturation and spawning. *Aquaculture Research* 38:1468-1477
- Ates, M.C.D., G.F. Qunitio, E.T. Qunitio and R.C. Sanares. 2011. Comparative study on the embryonic development of three mud crabs *Scylla* spp. *Aquaculture Research* 43:215-225
- Catacutan, M.R. 2002. Growth and body composition of juvenile mud crab, *Scylla serrata*, fed different dietary protein and lipid levels and protein to energy ratios. *Aquaculture* 208:113-123
- Catacutan, M., Eusebio P. and Teshima S. 2003. Apparent digestibility of selected feedstuffs by mud crab *Scylla serrata*, *Aquaculture* 216:253-261
- de Pedro, J., E.T. Qunitio and F.D. Estepa. 2007. Formalin as an alternative to trifuralin as prophylaxis against fungal infection in mud crab *Scylla serrata* (Forsskal) larvae. *Aquaculture Research* 38:1554-1562
- FAO. 2015. Fisheries and Aquaculture – Fisheries Global Information System. Crabs- Aquaculture production by species, country or area. *World Aquaculture Yearbook 2005-2014*, B-42. p. 106.
- Laranja J.L.Q., E.T. Qunitio, M.R. Catacutan and R.M. Coloso. 2010. Effects of dietary L-tryptophan on the agonistic behavior, growth and survival of juvenile mud crab *Scylla serrata*. *Aquaculture* 310:84-90
- Lavilla-Pitogo, C.R. and L. D. dela Pena. 2004. Diseases in farmed mud crabs *Scylla* spp.: Diagnosis, prevention and control. SEAFDEC/AQD, Iloilo, Philippines. 89 p
- Millamena, O.M. and E.T. Qunitio. 1999. Reproductive performance of pond-sourced *Scylla serrata* fed various broodstock diets. *In: Proceedings of the Mud Crab Scientific Forum, 20-24 April 1997, Darwin, Northern Territory, Australia. ACIAR Proceedings No. 78. 114-117*
- Parado-Estepa, F.D. and E.T. Qunitio. 1999. Larval survival and megalopae production of *Scylla* sp. at different salinities. *In: Proceedings of the Mud Crab Scientific Forum, 20-24 April 1997, Darwin, Northern Territory, Australia. ACIAR Proceedings No. 78. 174-177*
- Parkes, L., E.T. Qunitio and L. Le Vay. 2011. Phenotypic differences between hatchery-reared and wild mud crabs, *Scylla serrata* and the effects of conditioning. *Aquaculture International* 19:361-380
- Pates, G.S., Qunitio, E.T., Qunitio, G.F. and Parado-Estepa, F.D. 2016. Morphological deformities in mud crab *Scylla serrata* juveniles exposed to antibiotics during the larval stage. *Aquaculture Research* (in press)
- Philippine National Standards (PNS). 2016. Live mangrove crabs. PNS/BAFS 177:2016 ICS 67.120.30
- Qunitio, E.T., J. de Pedro and F.D. P. Estepa. 2007. Ovarian maturation stages of the mud crab *Scylla serrata*. *Aquaculture Research* 38:1434-1441
- Qunitio E.T., J.J. de la Cruz, M.R.R. Eguia, F.D. Parado-Estepa, G. Pates and C.R. Lavilla-Pitogo. 2011. Domestication of the mud crab *Scylla serrata*. *Aquaculture International* 19: 237-250.
- Qunitio, E.T., F.P. Estepa and V. Alava. 1999. Development of hatchery techniques for the mud crab *Scylla serrata*. 1. Comparison of feeding schemes. *Proceedings of the Mud Crab Scientific Forum, 20-24 April 1997, Darwin, Northern Territory, Australia. ACIAR Proceedings No. 78*
- Qunitio, E.T., F.D. Parado-Estepa, O.M. Millamena and E.M. Rodriguez. 2001. Seed production of mud crab *Scylla serrata*. *In: Proceedings of the International Forum on the Culture of Portunid Crabs. Millamena O.M, Qunitio E.T and Blackshaw A. eds. 1-4 December 1998. Asian Fisheries Science* 14(2):161-174.
- Qunitio, E.T., Libunao, G.X.S., Parado-Estepa, F.D. and Calpe, A.T. 2015. Soft-shell crab production using hatchery-reared mud crab. *Aquaculture Extension Manual No. 61. SEAFDEC Aquaculture Department, Iloilo, Philippines. 25 pp*
- Rodriguez, E.M., E.T. Qunitio, F.D. Parado-Estepa and O.M. Millamena. 2001. Culture of *Scylla serrata* megalops in brackishwater ponds. *In: Proceedings of the International Forum on the Culture of Portunid Crabs. Millamena O.M, Qunitio E.T and Blackshaw A. eds. 1-4 December 1998. Asian Fisheries Science* 14(2):185-190

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# CALENDAR OF EVENTS

Date	Venue	Title	Organizer(s)
<b>2017</b>			
20-24 February	Binangonan, Philippines	Training Course on Freshwater Prawn Hatchery & Grow-out Operations	SEAFDEC/AQD
28 Feb-2 Mar	Bangkok, Thailand	6 <sup>th</sup> Meeting of the Gulf of Thailand Sub-region	SEAFDEC-Sweden Project
7-8 March	Kuala Lumpur, Malaysia	Workshop on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region	SEAFDEC/MFRDMD
13-17 March	Binangonan, Philippines	Training Course on Tilapia Hatchery & Grow-out Operations	SEAFDEC/AQD
27-28 March	Bangkok, Thailand	Technical Consultation on ASEAN Common Fisheries Policy	DOF Thailand
29-30 March	Bangkok, Thailand	Working Group Meeting for Follow-up Activities on Joint Program on Tuna Research in Sulu and Sulawesi Seas	SEAFDEC/TD
3-7 April	Brunei Darussalam	49 <sup>th</sup> Meeting of the SEAFDEC Council	SEAFDEC Secretariat
19 Apr-3 May	Tigbauan, Philippines	Training Course on Sandfish ( <i>Holothuria scabra</i> ) Seed Production, Nursery & Management	SEAFDEC/AQD
24-28 April	Binangonan, Philippines	Training Course on Carp Hatchery & Grow-out Operations	SEAFDEC/AQD
10-30 May	Iloilo, Philippines	Training Course on Abalone Hatchery & Grow-out	SEAFDEC/AQD
15-16 May	Singapore	9 <sup>th</sup> Meeting of the ASEAN Fisheries Consultative Forum (AFCF)	ASEAN Secretariat
15-19 May	Binangonan, Philippines	Training Course on Freshwater Prawn Hatchery & Grow-out Operations	SEAFDEC/AQD
17-19 May	Singapore	25 <sup>th</sup> Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGF)	ASEAN Secretariat
5-9 June (Tentative)	Binangonan, Philippines	Training Course on Tilapia Hatchery & Grow-out Operations	SEAFDEC/AQD
20 June-26 July	Iloilo, Philippines	Training Course on Marine Fish Hatchery	SEAFDEC/AQD
10-13 July	Malaysia	Regional Training Course on Specimen Preservation and Its Application in Harmful Algal Bloom (HAB) Monitoring and Studies	SEAFDEC/MFRD
25-27 July (Tentative)	Singapore	Cold Chain Management for Seafood: Project Evaluation and Progress Meeting	SEAFDEC/MFRD
27 July	Kuala Terengganu, Malaysia	25 <sup>th</sup> MFRDMD Anniversary Celebration	SEAFDEC/MFRDMD
30 Jul-3 Aug	Kuala Terengganu, Malaysia	Advance Training Course on Stock Assessment: Risk Assessment for Neritic Tunas	SEAFDEC/MFRDMD & Secretariat
July (Tentative)	Iloilo, Philippines	44 <sup>th</sup> Anniversary Celebration of AQD	SEAFDEC/AQD
July (Tentative)	Thailand	Meeting on Mid-term Evaluation of Implementation on RFVR 24 Meters in Length and Over and Initiative on RFVR Below 24 Meters	SEAFDEC/TD
6-10 August	Kuala Terengganu, Malaysia	Workshop on Identification of Sharks and Rays in the Southeast Asian Region	SEAFDEC/MFRDMD
22-24 August	Makassar, Indonesia	RTC for the Project on Enhancing Coastal Community Resilience for Sustainable Livelihood and Coastal Resources Management	SEAFDEC/MFRDMD
4-7 September	Manila, Philippines	4 <sup>th</sup> Scientific Working Group Meeting on Neritic Tunas	SEAFDEC/MFRDMD & Secretariat
14-18 August	Binangonan, Philippines	Training Course on Tilapia Hatchery & Grow-out Operations	SEAFDEC/AQD
14 Aug-4 Sep	Tigbauan, Philippines	Training Course on Mangrove Crab Hatchery & Nursery Operations	SEAFDEC/AQD
21-25 August	Tigbauan, Philippines	Training Course on Catfish Hatchery & Grow-out Operations	SEAFDEC/AQD
August (Tentative)	Bangkok, Thailand	RTC on Fishery Statistics and Information in Southeast Asia	SEAFDEC Secretariat
12-14 September	Kuala Lumpur, Malaysia	Core Expert Meeting on Purse Seine Fisheries	SEAFDEC/MFRDMD
26-29 September	Vung Tau, Viet Nam	On-Site Training on Elasmobranch Taxonomy and Biology	SEAFDEC/MFRDMD
16-18 Oct	Kuala Lumpur, Malaysia	RTC on Promotion of the ASEAN Guidelines on Preventing the Entry of IUU Fish and Fishery Products into the Supply Chain	SEAFDEC/MFRDMD
15 November	Bangkok, Thailand	50 <sup>th</sup> SEAFDEC Anniversary Event	SEAFDEC

## Southeast Asian Fisheries Development Center (SEAFDEC)

### What is SEAFDEC?

SEAFDEC is an autonomous intergovernmental body established as a regional treaty organization in 1967 to promote sustainable fisheries development in Southeast Asia.

### Mandate

To develop and manage the fisheries potential of the region by rational utilization of the resources for providing food security and safety to the people and alleviating poverty through transfer of new technologies, research and information dissemination activities

### Objectives

- To promote rational and sustainable use of fisheries resources in the region
- To enhance the capability of fisheries sector to address emerging international issues and for greater access to international trade
- To alleviate poverty among the fisheries communities in Southeast Asia
- To enhance the contribution of fisheries to food security and livelihood in the region

### SEAFDEC Program Thrusts

- Developing and promoting responsible fisheries for poverty alleviation
- Enhancing capacity and competitiveness to facilitate international and intra-regional trade
- Improving management concepts and approaches for sustainable fisheries
- Providing policy and advisory services for planning and executing management of fisheries
- Addressing international fisheries-related issues from a regional perspective



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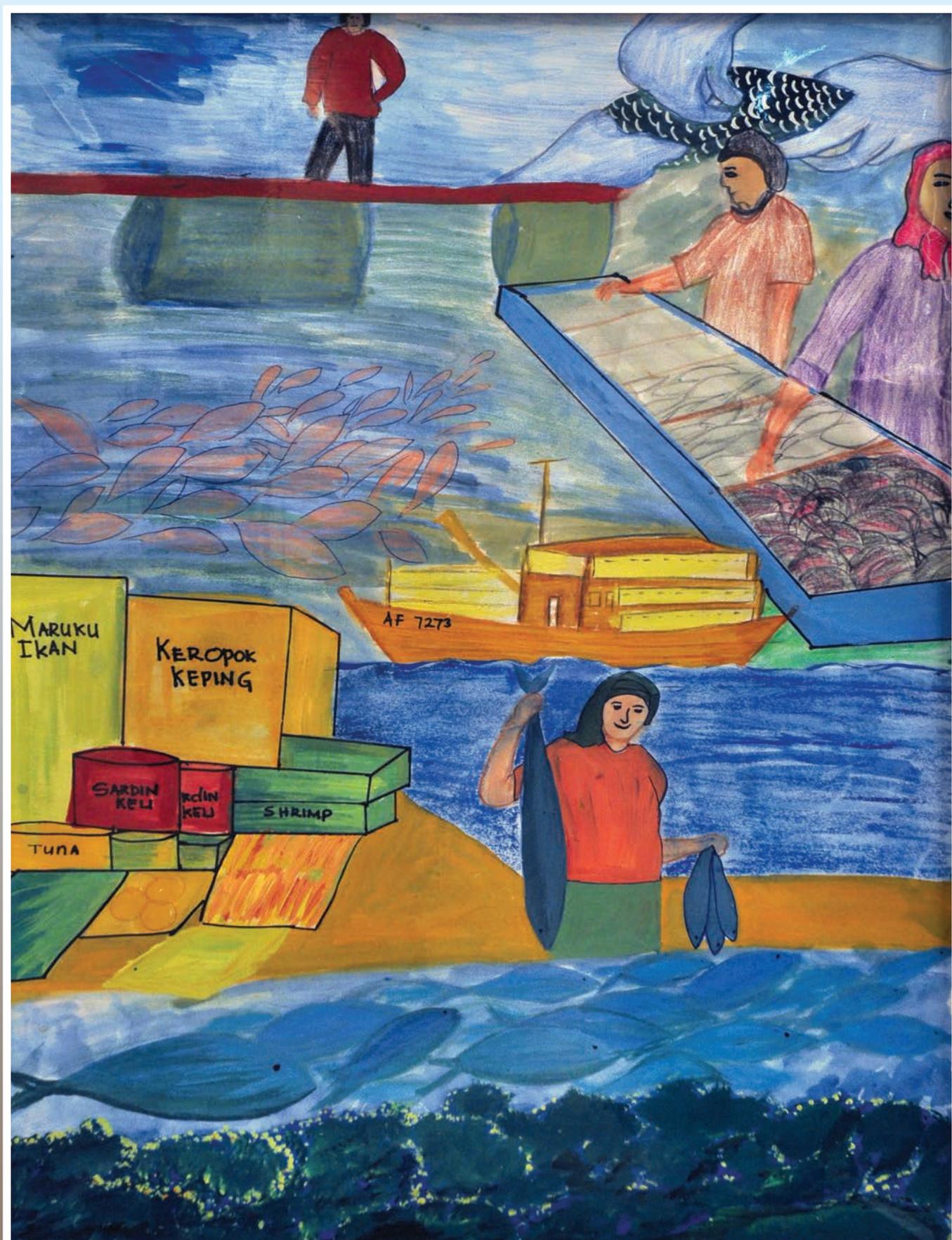
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The second prize drawing winner, *Mohd Arif bin Mohd Salleh*, from the national drawing contest in Malaysia

National Drawing Contests were organized in all ASEAN-SEAFDEC Member Countries as part of the preparatory process for the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security Towards 2020 "Fish for the People 2020: Adaptation to a Changing Environment" held by ASEAN and SEAFDEC in June 2011 in Bangkok, Thailand, in order to create awareness on the importance of fisheries for food security and well-being of people in the region.