

Box 26. Key achievements and improvements attained from the application of the community-based and co-management approaches

- **Development of management and conservation plan**

The development of fisheries management and conservation plan or the rules and regulations is being carried out effectively through participatory approach among the stakeholders concerned, leading to the recognition of the community management plan by the government officers and the community. Moreover, the technical support provided by the SEAFDEC/TD Project and the local government offices had increased the confidence of the fishers in developing and implementing the fisheries management plan by themselves.

- **Improvement of stocks**

Demarcation of the conservation area and enforcement of closed season including MCS is being effectively undertaken through the collaborative efforts between the fishers and government officers, especially in the pilot sites in Lao PDR and Thailand. As a result, the fishers could catch more fish after the project implementation. As for Cambodia, the promotion of crab bank in the pilot site had increased the awareness of local fishers on resources conservation especially the blue swimming crab, which is economically important for the country.

- **Reduction of conflicts in communities**

The cooperation among fishers within communities for the establishment FMCs, formulation of the community rules and regulations, and the collaborative work to address the problems together, had facilitated the reduction of conflicts among the stakeholders in the communities. These had also led to reduced practice of illegal fishing by the community fishers.

- **Enhancement of the roles of women in fisheries-related activities**

Specifically in Lao PDR, the skills of women in fish processing and marketing have been improved. The women's groups have been able to develop their products and find more marketing channels. As a result, the women could generate additional incomes for their households instead of depending only on the fishing activities of their respective husbands. In the pilot sites in Thailand and Lao PDR, the women also play the important role of providing advice during negotiations when problems occur.

6.1.3 Habitat Protection and Fishery Resources Enhancement

Fishery resources play significant roles in the social and economic aspects of the world. They provide not only a primary source of protein to people but also contribute to their livelihoods especially in coastal and rural areas in the Southeast Asian region. Several countries in the Southeast Asian region are among the top fisheries producers in the world. In 2017, the marine fisheries production in the region was recorded at around 17.33 million mt generating USD 25,292 million (SEAFDEC, 2020a). This was due to the coastal ecosystem in the region being very productive, having high biodiversity of marine fish species, and providing multiple ecosystems and suitable for habitats to fisheries resources.

It is recognized that optimum utilization and a healthy ecosystem is prerequisite for sustainable fisheries production. However, during the past several decades, the growth of regional and national human populations, as well as the development of aquaculture and fishery-related industries, have made great demands on fishery products. Unfortunately, these had increased the demands and the corresponding technology has resulted in the overexploitation of some economically important pelagic and demersal species. The continued dwindling of fishery resources compels most fishers to increase the use of modernized and more effective but destructive fishing methods which adversely impacted the ecosystem, particularly stocks and habitats.

Therefore, strategic fisheries management in the Southeast Asian region is urgent and should be directed towards reducing human pressure on fishery resources, the ecosystem as well as their habitat. Accordingly, the

Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2030 include provisions encouraging the AMSs to “Promote resource enhancement approaches with appropriate monitoring and evaluation programs, e.g. deployment of appropriate resource enhancement structures, restocking of commercially-important aquatic species, and restoration of degraded habitats, taking into consideration possible socio-ecological impacts” (Plan of Action No. 35) and “Promote the adoption of different management approaches to sustainably manage major critical coastal habitats, e.g. mangroves, coral reefs, and seagrasses; and develop and disseminate information and guidance on the use of appropriate tools and interventions” (Plan of Action No. 37).

Programs for Habitats Protection and Fishery Resources Enhancement

The programs that have been implemented to alleviate the declining resources or ecosystem degradation include 1) artificial reefs & habitats rehabilitation, 2) catch area management, and 3) restocking & releasing (**Boxes 27 and 28**). It should be noted that these programs should not be carried out as a stand-alone measure but should be integrated with other management measures to ensure the sustainability of the fishery resources.

Issues and Challenges

In the past decades, the deployment of ARs and establishment of MPAs, closed season, and *refugia* area were conducted to protect habitat and enhance fisheries resources. However, there is a concern that some are being implemented too quickly, with the intention of meeting political rather than conservation and enhancement targets.

It is developed without proper research, planning, or governance mechanisms. This issue is compounded further by insufficient government funds for both management and enforcement (Savage *et al.*, 2020).

In general, catch area management can be used as a management tool for the fishery with high fishing pressure. However, the common problem of catch area management at the national level is not enough protection afforded for highly migratory species, which often require large and continuous catch management areas. It could be occurred

by collaborating at the regional level. Additionally, the key success of catch area management is enforcement with requires a significant number of human resources, and associated financing funds which are still lacking in the region.

Resource enhancement through releasing eggs, larvae, and juvenile is a popular method in Southeast Asian countries. However, the capability to produce and release juveniles from aquaculture facilities is limited as well as lack of seed production techniques and facilities.

Box 27. Programs for habitats protection and fishery resources enhancement implemented by the ASEAN Member States
<p>Artificial reefs & habitat rehabilitation (A&H): There is a positive correlation between habitat ecology and abundance of resources. In this regard, artificial reefs (ARs) and habitat rehabilitation programs have been implemented throughout Southeast Asia. It has been proven to be an effective program to enhance fishery resources in the areas with low productivity and prevent encroachment of illegal fishing gear in the prohibited areas like coastal areas or the degraded habitats such as coral reefs, seagrasses, and mangroves.</p>
<p>Catch area management (CAM): This program could be the solution to consider marine areas in which specific management measures are applied to improve the productivity of habitats to sustain resource recruitment. Commonly, it relates to fishing prohibition schemes such as marine protected areas (permanently regulate fishing activities either by restricting access or regulating activities in an area), closed season area (some fishing gears, mostly commercial scale, are restricted to a certain time of year) and fisheries <i>refugia</i> (prohibiting catch during the critical stage of the life cycle of target species), and others.</p>
<p>Restocking and releasing (RR): This program usually refers to enhancement of fishery resources by releasing early life stages of aquatic animals to the wild. The key success depends on knowing enough about the ecology of the species, their nursery habitats, and the survival of released life in the wild. All the AMSs have their own releasing program. However, the capacity to produce and release life from aquaculture facilities or cages placed in the sea is limited.</p>
<p>Others: Programs of reducing degraded habitat and overfishing includes restrictions on fishing gear, fishing effort, zoning and licensing, EAFM and community based management, and fishery regulations, etc.</p>

Box 28. Programs for habitats protection and fishery resources adopted by the AMSs
<p>Brunei Darussalam</p> <ul style="list-style-type: none"> • A&H: Since 1985, the Department of Fisheries of Brunei Darussalam had developed and set up various types of ARs (<i>e.g.</i> used tires, redundant oil jackets, and concrete and stainless steel prefabricated pyramidal structures). Moreover, AR sites were also established for eco-tourism activities (FRA-SEAFDEC, 2010) • CAM: Six MPAs (20 % of the total fisheries management area) were established where fishing activities are restricted • RR: A total of 500,000 hatchery-reared postlarvae and juveniles of <i>Macrobrachium rosenbergii</i> were released into the Temburong River for stock enhancement • Others: In 2021, trawl fishing was banned in waters of Brunei Darussalam. Also, catching, landing, and importing of sharks and rays have been banned
<p>Cambodia</p> <ul style="list-style-type: none"> • A&H: More than 350 conservation areas had been rehabilitated through mangrove reforestation resulting in enhanced fish stocks and increased fish production through community participation. Moreover, a total of 165 units of ARs concrete modules and base, and logs of trees were deployed in 2017 in the Tonle Sap Great Lake at depths of less than 10 m. Also, two ship containers were deployed in 2017 in Koh Rong Saloem, Preah Sihanouk. • CAM: Since September 2019, the mackerel <i>refugia</i> was established at Peam Krasob, Koh Kong Province, and aimed at 1) raising public awareness of the proclamation on creation of management area to community fisheries, local authorities and fishermen, 2) installing mooring buoys at the boundary of <i>refugia</i> sites, and 3) enforcing closed fishing season of mackerel. • RR: In 2021, the blue swimming crab bank program was initiated in the <i>refugia</i> site in Koh Po, Kep Province with the goal of releasing at least 30 kg of blue swimming crab each year
<p>Indonesia</p> <ul style="list-style-type: none"> • A&H: Three types of AR models had been promoted, namely: cube shape model, dome model, and pyramid model. The materials used include used tires, out-of-commission steel structures, and old or confiscated pedicab units • CAM: The country is in the process of establishing <i>refugia</i> sites in West Kalimantan for banana shrimp in mangrove areas and in Bangka Belitung for squid (<i>Uroteuthis chinensis</i>) in coral reefs and seagrass beds • Others: Stock enhancement activities include determining the bio-limnological characteristics of release sites, developing of fisheries co-management approach, and making use of local knowledge for the management of the sites
<p>Malaysia</p> <ul style="list-style-type: none"> • A&H: Research and development of artificial reefs (ARs) program in Malaysia was started in year 1975 by using discarded tires, PVC pipe, ceramic, concrete culvert and confiscated fishing vessels. Findings from previous studies had led to the development of complex and durable structures of ARs in the coastal areas, that are made from reinforced concrete, steel, and decommissioned oil rig platforms. Approximately more than 215 new large size ARs site were established from 2006-2020 by the Department of Fisheries Malaysia (DoFM) within five nautical miles radius from the coastline. Besides deploying new AR structures yearly, scheduled monitoring programs have also been conducted to determine the effectiveness of AR structures in increasing the surrounding fish biomass and biodiversity ...

Box 28. Programs for habitats protection and fishery resources adopted by the AMSs
Malaysia (Cont'd)

- CAM: The catching of anchovy in Kedah waters was prohibited in September 2020. Meanwhile, special *refugia* for shrimp in Sarawak and lobster in Johor had been established following the concept of *refugia* similar to that in Sarawak known as the “tagal system” for the seasonal conservation of the freshwater fish, Malaysian red mahseer (*Tor tombooides*)
- Others: Exit Policy for trawlers in Zone B and Zone C was established and partly implemented in the east coast of Peninsular Malaysia in 2021. Also, the catch size of short mackerel and Indian mackerel using purse seine in Zone C in Perak State was controlled in 2020

Myanmar

- A&H: Although AR deployment and coral planting have not yet been established in the country, the Department of Fisheries of Myanmar recognized that ARs play important role in marine aquatic resources enhancement and intends to establish the country's AR program but technology on the development of ARs and financial support for such development would be required
- CAM: the country is in the process of identifying the spawning area which will be managed by a closed season approach where all fishing activities are prohibited for three months (15 February to 15 May) each year
- Others: Inland fisheries management in Myanmar is divided into two categories, *i.e.* leasable fisheries and open fisheries. In leasable fisheries, fishing rights are granted to lease-holders under a lease agreement subject to stipulations relating to the area, species, fishing implements, period, and fishing methods used. The lease-holders are responsible for carrying out stock enhancement and conservation of fisheries habitats. Moreover, selective harvesting of stocks is also being promoted while means of protecting the inland fishery resources from illegal fishing activities are also being developed

Philippines

- Others: The National Program on the Fisheries Enhancement of Inland Waters was launched covering 36 minor lakes and 320 small reservoirs to increase the country's fisheries production from inland fisheries, rehabilitate and/or restore the physical conditions of the country's minor lakes and reservoirs, enhance fisheries, and repopulate indigenous aquatic species in support of biodiversity conservation, poverty alleviation, and food sufficiency

Singapore

- A&H: The main objective of ARs is to provide coral larvae with elevated and stable settlement surfaces which could reduce smothering by sediment or scouring by rubble
- CAM: The Sisters' Islands Marine Park is a 40-ha marine park established for habitat conservation, research, education & outreach, and other recreational uses (except recreational fishing, as all of the marine park is a no-take zone)

Thailand

- A&H: Since 2019, the Department of Fisheries was providing support to the fishing communities to increase the fish habitat through the construction of fishing enhancing devices (FEDs) using natural materials such as coconut leaves
- CAM: The establishment of *refugia* sites for short mackerel in Trat Province and blue swimming crab in Surat Thani Province is being considered. The habitats in Trat Province include coral reefs, mangroves, and seagrass beds where purse seine and trawl operations are proposed to be regulated and prohibited during the closed seasons; while the habitats in Surat Thani Province include mangroves and seagrass beds where fishing operations are proposed to be prohibited
- RR: Providing support to the coastal fishing communities to implement aquatic animal bank, particularly crab bank and cuttlefish bank. Also, breeding and releasing of other economically important species such as spotted Babylon, banana shrimp, tiger prawn, blue swimming crab, mangrove crab, and sea cucumber are carried out
- Others: Thailand has measures of restricting the number and size of fishing vessels and fishing efforts to control fishing capacity. The marine resources in the Gulf of Thailand and the Andaman Sea are categorized into three separate species groups: (1) demersal, (2) pelagic, and (3) anchovies. The precautionary approach is used as the guiding principle, and maximum sustainable yield (MSY) of the three combined resource categories is used as a reference point in setting the total allowable catch (TAC) limits in this exercise. The number of fishing days per vessel per year is stipulated by issuing licenses based on the TAC size and total allowable effort (TAE) (Department of Fisheries Ministry of Agriculture and Cooperatives, Thailand, 2015)

Viet Nam

- A&H: The ARs used are reef balls, cylinder reefs, and cube reefs installed in several places such as in Ninh Thun (2011), Quang Nam (2014), Nahe An (2015), Phu Quoc (2018), Nha Trang (2019), Ca Mau (2020) and Thai Binh (2020). Also, Nha Trang University had installed ARs (200 cylinder reefs and 100 cube reefs) in Ninh Thuan Province to protect, recover, and develop fisheries resources
- CAM: Monitoring of the country's MPAs is done once a year and the results were used as a basis in formulating policies and regulations on the protection and development of aquatic resources. Engagement of the stakeholders during the process of establishing the conservation zones helped in pooling the knowledge and experience of local stakeholders, *e.g.* officers, fishers, scientists, and government authorities (Hung, 2021)
- RR: “Marine Animal Bank” is currently schemed to promote stock enhancement

Since the 1970s, the Southeast Asian countries have had long historical in place their respective national legislations, policies, and program regarding habitats protection and fisheries resources enhancement to promote conservation and management of the marine resources. It is necessary to evaluate the effectiveness of those implementations. This is a basic requirement of policymakers. However, only a few are conducting due to limitations on the knowledge and skills, and lack of published materials such guidelines.

Publishing of evaluation guidelines as well as capacity-building evaluation methods and techniques are among the challenges in the region.

Recommendations and Way Forward

Multispecies stock assessment should be considered rather than the single-species stock assessment for sustainable fisheries management. To ensure the success of habitats

protection and fisheries resources enhancement, it is vital that a plan of action highlighting the key activities in a strategic plan and the sequencing of these activities in the proper time frame be put in place. The national or regional plan should also indicate the responsible agencies for initiating action or assigning tasks to be accomplished to meet the objectives within the stipulated duration of time.

To restore fishery resources, several management tools including the installation of ARs have been applied. However, the disadvantages of the ARs are the lack of collaboration between the government and fishers, in which the fishers are only involved in the identification of fishing ground and following the regulations. Therefore, the absence of fisher co-management could not effectively promote resources management because the fishers have always the tendency to disobey due to lack of ownership. Hence, seeking modern tools to enhance the fishery resources by incorporating the resource users to be resource managers is required. For example, fish enhancing devices (FED) or known as floating ARs, are currently being explored in the Philippines and other countries in the western Pacific including Thailand (Cabral *et al.*, 2014; Manajit *et al.*, 2019).

Sharing indigenous and scientific knowledge (particularly impact assessment of degraded natural habitats and fisheries resources due to human activities) among the stakeholders targeting on raising awareness on the importance of habitats and fisheries resources to humans should be conducted regularly. Research on habitat and fisheries resources enhancement should be continuously carried out, and the results could significantly support the policy formulation as well as increase fishers' acceptance when the management plans are implemented. The future activities of the ongoing project "Sustainable Utilization of Marine Fisheries Resources and Resource Enhancement in Southeast Asia" implemented by SEAFDEC/TD from 2020 to 2024 include fish larvae identification and determining of spawning-nursing grounds and season using larvae survey results, artificial reef design and construction, and evaluating methods of enhancing fisheries program in terms of environment and fisher economy.

6.1.4 Application of Fishery Information Systems for Fisheries Management

Geo-information technology refers to an integration of knowledge and technologies involving Geographic Information System (GIS), Remote Sensing (RS), and Global Navigation Satellite System (GNSS), which could be applied in a wide range of work (GISTDA, 2015). GIS is commonly used for visual display, quantification, and analyses of spatial data. Ecological data, including fisheries data, generally contain a spatial component and are well suited for analysis through GIS. Moreover, RS is the process

of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance. RS could therefore be used to classify objects on earth, including those on the surface as well as in the atmosphere and oceans, based on propagated signals. (Eder & Neely, 2013).

These technologies, such as the GIS and RS applications, could be used in various stages of monitoring, conservation, management, sustainable development, and environmental protection, and so on. Results of analysis using the GIS technology could be applied to any decision-making plans quickly and accurately (GISTDA, 2015). GIS and RS technologies are potential tools for fisheries management especially when it comes to decision-making processes, as they could give clear visualization of the data and information in place and time. Over the past decades, there were a lot of instances where GIS and RS had been used in fisheries science and found to have the capability to support the management of fisheries and aquaculture in various aspects.

Application of GIS and RS

The recent activities of SEAFDEC that aim to support and encourage the Southeast Asian countries to utilize the GIS and RS technologies for the sustainable utilization of the fishery resources in the region, SEAFDEC/TD initiated in 2020 the five-year project "Sustainable Utilization of Fisheries Resources and Resources Enhancement in Southeast Asia" which includes the activity to use Fisheries GIS or FGIS and RS to improve fisheries management. At the onset, the "Regional Consultation Workshop on the Utilization of FGIS and RS to Improve Fisheries Management in Southeast Asia" was organized in 2020 to update the SEAFDEC Member Countries on the use of GIS and RS in research and studies on fisheries and environmental science. Information on the status of utilization of these technologies in the studies or research activities in the SEAFDEC Member Countries, compiled during the Regional Consultation Workshop, are summarized in **Box 29** (SEAFDEC/TD, 2020).

Issues and Challenges

Although raised in the 1990s, the major challenges for GIS and RS applications (**Box 30**) have not yet been fully addressed (Nishida, 1994) because of the fragmented nature of the fisheries, especially in the Southeast Asian region.

Available resources

The current available resources that could be used to support the application of GIS and RS in fisheries and aquaculture management are shown in **Box 31**. Accessibility to such resources is also indicated for easy reference.