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Strengthening Fishery Resource Rehabilitation Measures to Mitigate the Impacts of IUU Fishing

Yuttana Theparoonrat, Hajime Kawamura, Virgilia T. Sulit, and Nopporn Manajit

The coastal waters of Southeast Asia are blessed with fishery resources with high level of productivity because of rich ecosystems such as dense mangrove forests and sea grass beds sustained by rich effluence of nutrients from land, as well as extensive coral reefs with clean tropical sea environment. These areas are critical to a broad range of aquatic organisms during their life cycle from breeding, spawning, nursing and growing; host the feeding zones of aquatic species that are economically important; and serve as important source of recruitment of a wide diversity of aquatic resources. It is widely recognized that healthy aquatic environment is a prerequisite for sustainable fisheries production. Therefore, fisheries management in the Southeast Asian region should be directed towards realizing a good balance and relationship between human activities and coastal environment in order that aquatic resources could be utilized in a sustainable manner. Specifically, fisheries management should aim to safeguard the health and reproductive capacity of fish stocks through sustainable protection and conservation of the aquatic resources that provide the foundations for profitable fishing industry and promote equitable sharing of benefits for the resource users. However, most of the important fishery resources in the region are believed to have declined due to many factors that include overfishing, illegal fishing, use of destructive fishing practices, and environmental degradation. Inshore, the massive clearance of mangrove forests for aquaculture, urbanization, industrialization, wood fuel, timber and the like, has brought about large

destruction of the breeding, nursery and feeding areas of many aquatic species that might have been already destroyed and lost. Meanwhile, illegal, unreported and unregulated (IUU) fishing activities that continue to occur in many Southeast Asian waters result in overfishing ultimately leading to severe exploitation of fish stocks without allowing the stocks to reproduce, reduced catch and consequently deteriorating national economies. Recognizing such a scenario, the June 2011 ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security Towards 2020 “Fish for the People 2020: Adaptation to a Changing Environment” adopted the ASEAN Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020 that include provisions encouraging the ASEAN Member States (AMSs) to “Optimize the use of inshore waters through resources enhancement programs such as promoting the installation of artificial reefs and structures, encouraging coordinated and effective planning for coastal fisheries management programs, undertaking environmental impact assessment studies, restocking of commercially important fish species, as appropriate, and give priority to human resources development for the implementation of such programs” (Plan of Operation No. 27); and “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” (Plan of Operation No. 29).

Impacts of IUU Fishing on the Fishery Resources

Based on the definition of IUU fishing (FAO, 2001), a fishing activity is illegal when “operated in contravention of the conservation and management measures adopted by relevant regional fisheries management organizations (RFMOs) by which States are bound;” and is unregulated when “operated in areas or for fish stocks in relation to which there are no applicable conservation or management measures and where such fishing activities are conducted in a manner inconsistent with State responsibilities for the conservation of living marine resources under international law.” Report of a study carried out by MRAG (2005) adopted the concept that a “fishing activity could be classified as IUU if it constitutes action that is, under the definitions, either illegal, unreported or unregulated.” MRAG (2005) also considered that IUU fishing activities could include “illegal and unlicensed fishing in EEZs, incursions into EEZs by vessels fishing in adjacent high seas waters or licensed to fish in adjacent country waters; and unregulated fishing in high seas waters undertaken both in areas of RFMOs by non-parties or in contravention of the conservation efforts of those RFMOs, or any fishing in areas not covered by RFMOs.”

The AMSs have been exerting efforts to counter illegal fishing operations as these have become contributory factors to the over-exploitation and destruction of fish stocks, through the promotion of effective fisheries management. Illegal fishing in this context includes poaching by foreign fishing vessels and fishing using destructive practices such as the use of dynamite and cyanide that completely devastate the fishery resources and fish habitats (Torell, *et al.*, 2010). However, it has also been recognized that the increasing demand for seafood worldwide pushes fishers to illegally fish and poach on seas of neighboring countries outside of their jurisdictions.

If uncontrolled, illegal and unregulated fishing activities could therefore impede the recovery of fish stocks that had been



Community-based stock enhancement demonstration site (a 4,000 m² coral patch (*Porites* sp.)) in Brgy. Molocaboc, Sagay City, Philippines (Salayo *et al.*, 2016)

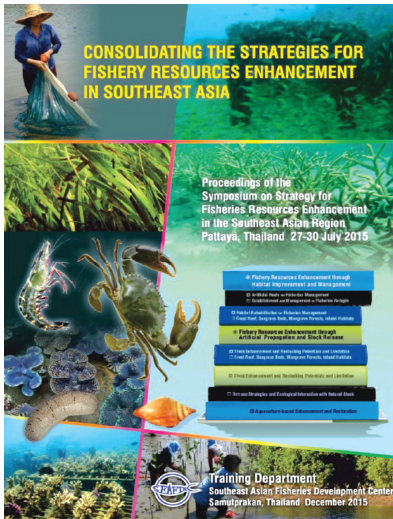
over-fished eventually ending up with degraded resources even at the verge of stock collapse, inducing increased competition among resource users and severely affecting the economic and social well-being of fishing communities (Kawamura and Siriraksophon, 2014).

Hence, fisheries management should aim for safeguarding the health of fish stocks to sustain an equitable, viable and profitable fishing industry. Within such objective, there is a need to strengthen fishery resource conservation, protection and rehabilitation to mitigate the impacts of illegal and unregulated fishing activities on the fishery resources.

Initiatives of SEAFDEC and AMSs to Mitigate the Impacts of IUU Fishing on the Fishery Resources

Considering that most of the fishery resources in the Southeast Asian waters are already in various levels of decline mainly due to illegal and unregulated fishing activities, and in an effort to address the concerns on resources degradation, SEAFDEC with funding support from the Japanese Trust Fund (JTF), carried out a five-year program on the “Promotion of Sustainable Aquaculture and Resource Enhancement in Southeast Asia” starting in 2010. Implemented in the Southeast Asian countries, the program was conceptualized based on two approaches, namely: improvement of critical habitats/nursing grounds of fishery resources; and direct enhancement of fisheries resources through artificial propagation techniques. Thus, under such program, the project on “Rehabilitation of Fisheries Resources and Habitats/Fishing Grounds through Resources Enhancement” was implemented by the SEAFDEC Training Department (SEAFDEC/TD) based in Thailand to serve as immediate response to the concerns on the deteriorating coastal and inland ecosystems, and preventing further loss of habitats and eventual damage to the aquatic organisms. Simultaneously, the Philippine-based SEAFDEC Aquaculture Department (SEAFDEC/AQD) carried out the project on “Resource Enhancement of Internationally Threatened and Over-exploited Species in Southeast Asia through Stock Release” including the establishment of strategies of stock enhancement through sustainable, responsible and environment-friendly approaches.

As the abovementioned projects involved identification of appropriate resource enhancement strategies that could serve as guide for the countries in the region in their efforts towards rehabilitating their respective fishery resources, SEAFDEC with support from the JTF organized the “Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region” in Thailand in July 2015. Organized with two-pronged themes, *i.e.* Fishery Resources Enhancement through Habitat Improvement and Management; and Fishery Resources Enhancement through Artificial Propagation and Stock Release, the Symposium compiled, consolidated and exchanged necessary information and technologies based on



the countries' initiatives to enhance the fishery resources that might have already been degraded and destroyed due to illegal and unregulated fishing practices (Kawamura, *et al.*, 2016).

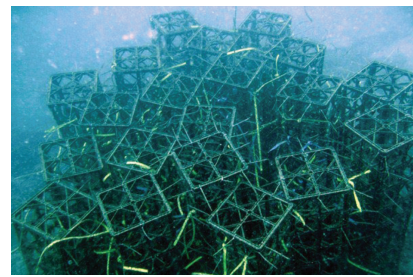
In order to promote fishery resources enhancement measures in critical habitats and fishing grounds, the AMSs have been carrying out R&D activities on various enhancement measures, *e.g.* installation and management of artificial reefs (ARs), management of fisheries *refugia* and marine protected area (MPAs), habitat diagnosis and rehabilitation, restocking and stock restoration. The experiences and lessons learned by the ASEAN-SEAFDEC Member Countries and the initiatives of SEAFDEC (**Box 1**) were shared during the abovementioned Symposium (Kawamura, *et al.*, 2016). Based on the inputs from the SEAFDEC Member Countries and outputs of relevant SEAFDEC projects, the Symposium also came up with Policy Recommendations and Strategic Plans for Fisheries Resources Enhancement in the Southeast Asian Region (**Box 2**).



Abalone juveniles rearing and releasing to the sea for conservation in Bach Long Vi National Marine Protected Area, Viet Nam (Chieu *et al.*, 2016)



Fish stocks aggregating in cuboid ARs installed in Malaysia (Zainudin, 2016) (*above*)



Fish apartments installed in Indonesian waters serve as refuge for fish stocks and prevent encroachment of the fishing areas by illegal fishers (Anjaresta and Agung, 2016) (*left*)

Way Forward

The Policy Recommendations and Strategic Plans for Fisheries Resources Enhancement in the Southeast Asian Region adopted during the July 2015 Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region, were used as basis for the development of activities under the Project on Rehabilitation of Fisheries Resources and Habitat/Fishing Grounds for Resources Enhancement in Southeast Asia from 2015 to 2019, also supported by the JTF.

The Project aims to identify the appropriate resource enhancement tools appropriate for the region as well as habitat conservation measures based on analysis and diagnosis of the effectiveness of the measures, and formulate strategies and guidelines for implementation in the Southeast Asian region. Capacity building on fisheries resource enhancement and habitat conservation measures would also be promoted in the ASEAN countries. The specific activities were formulated during the Regional Inception Workshop for JTF-6 Program on Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia organized in Thailand on 31 July 2015 by SEAFDEC with funding support from JTF. Moreover, the Project also aims to strengthen collaboration and cooperation among the SEAFDEC Member Countries for the promotion of sustainable fisheries resources enhancement in the Southeast Asian region to ensure the sustainability of such measures.

Box 1. Initiatives of the ASEAN-SEAFDEC Member Countries on fishery resources enhancement

Cambodia

- **Management of fisheries *refugia***
 - Blood Cockle *Refugia* was established in Preah Sihanouk, Cambodia to enhance and protect the habitats of blood cockles as mangroves and sea grass in natural sea beds
 - management approach for the blood cockle *refugia* takes into consideration various factors such as regulating blood cockle size to be harvested, taking into consideration the socio-economic viability of this resource
 - country's Community Fisheries established the self-regulatory measures, *i.e.* fishing rights and entry, fishing seasons and fishing hours, and harvestable size of blood cockle through consultations with the stakeholders, *e.g.* local fishers, local officers, government staff, researchers, and relevant organizations/agencies
 - in spite of such regulations, illegal fishing operations still prevail in the *refugia* area, especially by fishers from outside areas who collect the blood cockle using dragger with engine, a rampant practice which could easily deplete the blood cockle resources
- **Habitat rehabilitation and artificial reefs installation**
 - the country considers fishery resources as very important for food security and source of income for its rural fishers
 - decline in resources led to fishing competition and conflicts in fishing while the use of modern fishing techniques resulted in the gradual degradation of the fish habitats
 - fluctuating depths and temperature of the waters create impacts on the fishery resources as refuges are lost and eventually causing mass fish kills while in some cases, the capacity of fish to reproduce is reduced
 - Fisheries Administration (FiA) of Cambodia divided the responsibilities of managing the fishing grounds and conservation areas within the Community Fisheries (CF) domain to be managed by community fishers
 - more than 350 conservation areas had been rehabilitated by the community fishers resulting in enhanced fish stocks and increased fish production
 - community participation in the rehabilitation activities has been enhanced through volunteerism, and to raise funds for such activities, interested persons are encouraged to pay certain amount of funds while financial assistance are also sourced from donors
 - mangrove reforestation is a routine activity in the conservation areas where community fishers follow the rules and regulations on mangrove reforestation as prescribed by FiA
 - while conservation areas had been rehabilitated, community fishers also engage in alternative livelihoods, *e.g.* tourism in the Tonle Sap Great Lake, upon thorough consultations among the members of the CF
 - installation of ARs in lakes as means of protecting the fishing grounds from encroachment had been successfully carried out making use of tree trunks

Indonesia

- **Habitat rehabilitation**
 - the country rehabilitates and conserves the habitats by undertaking mangrove reforestation, coral transplantation, installation of fish apartments, and the like
 - engagement of the communities at the beginning of such activities is important to support the maintenance, monitoring, and nursery of rehabilitated habitats
 - fish apartments made of durable plastic materials that could last for more than 25 years, are used to support the aggregation of fish and serve as fish shelters
 - installed near fishing communities, fish apartments serve as refuge for fish stocks and prevent encroachment of the fishing areas by illegal fishers
 - concrete management actions is necessary to monitor the effectiveness of the fishery resources conservation and habitat rehabilitation activities
- **Restocking and stock restoration**
 - country's stock enhancement activities include determining the bio-limnological characteristics of the release sites, development of fisheries co-management approach, and making use of local wisdom or knowledge for the management of the sites
 - stock enhancement and culture-based fisheries are options to optimize the utilization of inland waters for producing fish, ensuring food security, creating additional income, and promoting human welfare
 - concerned government agencies also support and take active part in the activities, as well as providing local fish seeds for restocking purposes, *i.e.* Research Institute for Inland Fisheries in Palembang; Research Institute for Stock Enhancement in Java; and the SEAFDEC Inland Fishery Resources Development and Management Department in Palembang
 - parameters on nutrition of fish feeds should be considered to support the promotion of food security while policy support on stock enhancement should be sought
 - the numerous research activities on stock enhancement in inland waters have been undertaken the results of which could address the various technical concerns on and management of the released stocks

Japan

- **Management of artificial reefs**
 - country carries out two aspects of artificial reef activities: (1) artificial reef fishing ground for marine resources enhancement; and (2) measurement method on the effects of fish-gathering and fish-propagation around artificial reefs
 - in the past, artificial reefs had been constructed as auxiliary fishing gear to gather fish, and now artificial reefs have been constructed as fishing grounds to gather, propagate and protect fish from their larval/juvenile stages to adult stage, considering that in many cases, juvenile fish resources are extremely diminished
 - construction and installation of artificial reefs aim to expand natural reefs and create new fishing grounds with the same conditions as those of natural reefs
 - to date, a new type of ARs, known as “**upwelling reef**” is being promoted in Japan following the concept that when “rich nutrient salts near the bottom layer rise to the euphotic zone, primary productivity would be enhanced in the surrounding sea areas” leading to increased fishery production
 - constructed using concrete blocks and stones at sea bottom with depths of about 82 meters, “upwelling reef” is beneficial in terms of enhancing the primary productivity and fisheries production capacity of the surrounding sea areas

Box 1. Initiatives of the ASEAN-SEAFDEC Member Countries on fishery resources enhancement (Cont'd)

- **Habitat diagnosis and restoration**
 - drastic decrease of eelgrass in Hinase City from 590 ha in 1945 to 12 ha in 1985, prompted the local fishers to undertake eelgrass bed restoration since 1985
 - area of eelgrass beds recovered is now 200 ha or 1/3 of the area in 1945, and fish production using set net had also recovered starting 2011
 - oyster culture was started in 1985 in the same fishery ground so that together with the expansion of the eelgrass beds, harvest of oysters would be improved because eelgrass beds and oyster culture have a win-win relationship: oyster culture helps the expansion of eelgrass beds by the assimilation of detritus and increase sunlight transmittance depths (transparency), while eelgrass beds tend to decrease the mortality of cultured oysters in summer by decreasing water temperature in the water column
 - Hinase Fishermen Union would establish fish farms by integrating eelgrass bed, oyster culture rafts and artificial reefs in an arrangement where locally spawned fish grows in the designated farming area using the eelgrass beds, oyster rafts and artificial reefs as shelters
 - newly developed concept known as 'Sato-Umi' developed in Japan could be promoted as a fisheries management measure in coastal seas with high biodiversity and productivity as adapted in Hinase, as this could provide the means of increasing the abundance of eelgrass
 - 'Sato-Umi' concept is a form of unified management system for land and sea, where management mechanisms for coastal waters move inland, one step away from integrated coastal management so that land and sea are brought under a unified management policy
 - 'Sato-Umi' concept is meant for environmental conservation of coastal areas in harmony with human interaction on land
- **Restocking and stock restoration**
 - several stock enhancement programs had been carried out in Japan during the last fifty years aiming for cost-effectiveness and stocking efficiency
 - seeds of about 85 species of fish, mollusks, crustaceans and other aquatic organisms have been released in the country's waters for stock enhancement, e.g. chum salmon (*Oncorhynchus keta*) and barfin flounder (*Verasper moseri*) in northern Japan, red sea bream (*Pagrus major*) in central and western Japan, and Spanish mackerel or 'sawara' (*Scomberomorus niphonius*) in Seto Inland Sea, the largest inland sea in country
 - protocols to be considered in stock release: (1) **diagnosis** for stock assessment includes investigation of the ecology of target species considering that there is no need to release seeds if the natural stock is abundant, and investigations of the environment of nursery grounds as a prerequisite for effective seed release; (2) **planning** of the stock strategy (when, where, how, how many) and checking the quality of seeds for stocking (size, shape); (3) **establishing cooperation** with concerned fisherfolk for the fisheries management, habitat improvement and/or rehabilitation; (4) **monitoring** the market of target species through market survey taking into consideration the yield per release (YPR), and **evaluating** the impacts of stocking; (5) **implementing** the most efficient stocking strategy based on the results of the protocols considered
 - the carrying capacity of the nursery grounds should be assessed as it restricts the allowable number of released seeds, as in the case of *hirame* or the Japanese flounder (*Paralichthys olivaceus*), the number of release seeds was higher in northern Japan than in the south-western areas of the country
 - to evaluate stocking efficiency, the YPR which is equal to the weight of landed "recaptured fish" divided by the number of released seeds, should be determined, and the YPR for successful cases should be more than 50 metric tons per 1.0 million seeds stocked
 - on stock enhancement of Portunid crabs as the most important fishery resources in the coastal waters of Japan, e.g. swimming crab (*Portunus trituberculatus*), blue swimming crab (*P. pelagicus*) and mud crab species (*Scylla paramamosain* and *S. serrata*), about 30 million hatchery-produced juveniles have been released annually since the late 1980s since the annual catch of the Portunid crabs have fluctuated and in order to sustain and/or increase the Portunid crabs stock
 - estimating recapture rates of stocked crabs is indispensable to evaluate the effectiveness of stock enhancement programs, therefore marking methods should be developed to distinguish between wild and hatchery-released individuals
 - stocking effectiveness of Portunid crabs could be determined if appropriate methods to mark small body sized juveniles which frequently molt in their life cycle, are put in place
 - a technique has recently been developed to mark crab juveniles which could eventually estimate the contribution rates of released crabs to the total catch of mud crabs and swimming crabs
 - mixed rate of released juveniles in the total catch of mud crab could be estimated using genetic stock identification, which could be 5.0-19.7%, and the contribution of released juveniles to the total catch could be about 0.5-1.0 metric tons
 - recapture rate of released juveniles of the swimming crabs is estimated through a marking technique by clipping the swimming leg (dactylus), resulting in an estimated contribution rate of marked crabs to the landings of about 3.0%

Lao PDR

- **Habitat rehabilitation and artificial reefs installation**
 - pilot project in country's Nam Houm Reservoir has various activities, e.g. compilation of fisheries information and data, promotion of sustainable fisheries and the concepts of community-based and co-management in inland fisheries, strengthening the critical habitats by installing 50 pieces of high effective fish shelters as protective measures of broodstocks from illegal fishers, prohibition of certain fishing gears in conservation areas, transfer of technology on mobile hatcheries to fishers' groups in Nam Houm Reservoir for the breeding the common silver barb using hormones, and promotion of juvenile fish releasing techniques, among others
 - with water serving capacity 60 million m³ in wet season, Nam Houm Reservoir also supports agriculture activities
 - of the 36 species of economically important fishes in the Reservoir, the most valuable are tilapia (*Oreochromis niloticus*), featherback (*Notopterus notopterus*), and common silver barb (*Barbonymus gonionotus*)
 - since illegal fishing operations still take place even in the conservation zones, ARs had been installed in these zones by the Reservoir Fisheries Management Committee (ARs are made of concrete and other materials that would not drift with the strong flow of water current)

Box 1. Initiatives of the ASEAN-SEAFDEC Member Countries on fishery resources enhancement (Cont'd)

Malaysia

- **Artificial reefs installation**
 - The country has been implementing R&D activities on artificial reefs, *i.e.* construction and designs, materials used, site selection
 - artificial reefs installations serve as natural resources habitat, *e.g.* management of artificial reefs in Sabah by local fishermen's community established for the purpose of developing and protecting the artificial reef sites, as local communities should be involved especially the fishers to make sure that the construction plans and installation are beneficial to them, especially in terms of socio-economic returns
 - artificial reefs installation could minimize conflicts between traditional and commercial fishers by curbing possible encroachment of commercial fishers in traditional fishers' fishing areas
 - Malaysian Fisheries Act 1985 prohibits any fishing activities within the 0.5 nautical miles radius of artificial reef areas
- **Management of fisheries *refugia***
 - special *refugia* for two commodities *i.e.* shrimp and lobster had been established in Sarawak and Johor, respectively, following the concept of *refugia* similar to that in Sarawak, Malaysia known as the "tagal system" for the seasonal conservation of the freshwater fish Malaysian red mahseer (*Tor tombroides*)
 - to address the country's production of penaeid shrimps and lobsters that had been declining, activities had been initiated aiming to safeguard spawning aggregations, nursery grounds, and migration routes; protect and revive fish populations from being overfished; and increase and sustain catch and incomes of fishers and relevant stakeholders
 - in developing the aforementioned new concept of *refugia*, science-based information had been taken into consideration while agro-tourism aspects were explored so that local communities could generate additional incomes
 - such established *refugia* systems had been constrained by various factors, *e.g.* inadequate support from local communities; pollution from terrestrial activities especially the sludge coming from crude palm oil milling factory that flows into the *refugia* area; local communities not empowered to stop encroachment by illegal fishers in *refugia* areas; migratory characteristics of target commodities makes it difficult to manage the fisheries; and target fish species in the "tagal system" have become dependent on artificial diets provided by tourists instead of finding food by themselves from the natural environment
- **Restocking and stock restoration**
 - coral reef restoration activities had been carried out in the waters off Pahang and in Perhentian Island of Terengganu Province from 2010 to 2014
 - Malaysia is reported to have about 1,687 km² of coral reef areas with more than 540 species of hard corals, but only about 9% of the coral reef areas are protected under the country's MPA systems, while some of the coral reefs have been threatened by climate change, pollution, and illegal fishing among others, leading to massive coral bleaching and habitat loss
 - in an effort to rehabilitate the coral reefs, a pilot coral reef restoration project was launched through coral re-plantation, in the waters off Pahang and Terengganu starting in 2010
 - based on country's experience, site selection is a crucial aspect as the site should have moderate water current with unobtrusive sunlight, and should not be too near to adjacent natural reefs
 - coral fragments used for transplantation must be larger than 10 cm, and the site should be maintained immediately after the corals had been transplanted
 - some benefits of coral restoration include increased live coral cover, recovery of targeted coral reefs, increased biodiversity, re-establishment of ecological balance, and stabilizing the surrounding environment

Myanmar

- **Habitat rehabilitation**
 - the country's system of inland fisheries management includes dividing inland fisheries 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
 - lease holders must take the responsibility of carrying out stock enhancement and conservation of fisheries habitats
 - there are 3,729 leasable fisheries in Myanmar and culture-based system is applied in most of these leasable fisheries
 - inland fisheries and habitats have gradually degraded due to siltation, extension of agriculture, and road construction, among others
 - to conserve the fisheries habitats and fish stocks, several activities had been carried out in leasable fisheries rehabilitate and maintain the fisheries habitats and fish production in inland fisheries, including selective harvesting of stocks and protecting the inland fishery resources from illegal fishing activities

Philippines

- **Management of fisheries *refugia***
 - fisheries *refugia* has been established in the Philippines, *e.g.* in Busuanga, Palawan and in Zamboanga Peninsula
 - success of fisheries *refugia* depends on the actions at the local level with level of community support dependent on the involvement of local stakeholders in any relevant actions undertaken
 - while science-based management measures are most crucial, it is also necessary to harness local knowledge as this is critical for site selection and establishment of management measures
 - information and communication also help in enhancing communities' acceptance of the fisheries *refugia* approaches
 - the case in Busuanga, Palawan has led to the development of a model of fish egg dispersal and larval settling in Philippine waters, where the source and sink of fish eggs and larvae had been used in identifying the spawning and nursery *refugia*
 - the case in Zamboanga Peninsula meant to address the decreasing catch of sardines, led to the establishment of a management measure through the enforcement of 'closed fishing season' in the Peninsula's fishing ground, leading to increased catch of the sardines

Box 1. Initiatives of the ASEAN-SEAFDEC Member Countries on fishery resources enhancement (Cont'd)

- **Habitat diagnosis and restoration**
 - sea urchins (*Tripneustes gratilla*) and sea cucumber (*Holothuria scabra*) are invertebrates with important ecological functions in tropical near shore ecosystems, and function as reproductive reserves and source of larval supply to adjacent suitable habitats
 - culture and release of sea urchins and sea cucumber has been conducted to rebuild depleted populations and provide income to fishers
 - an integrated socio-ecological approach is necessary with active participation of local partners in site management and regular monitoring
 - although culture-based resource management is imperative, relevant factors should also be taken into consideration, e.g. investment and high associated risks, related science-based information, regular monitoring and evaluation, involvement of local stakeholders and decision makers
 - culture-based resource management should demonstrate the ecological and economic benefits, and identify where appropriate governance that is necessary as critical considerations for sustainability
- **Habitat rehabilitation**
 - inland fisheries resources in the Philippines comprise swamplands, lakes, rivers, and reservoirs, and host some 340 species of freshwater fishes
 - for increasing the country's fisheries production from inland fisheries, a National Program on the Fisheries Enhancement of Inland Waters was launched covering 36 minor lakes and 320 small reservoirs in 16 regions of the country
 - this program intends to rehabilitate and/or restore the physical conditions of the country's minor lakes and reservoirs, enhance fisheries, and repopulate indigenous species in support of biodiversity conservation, poverty alleviation and food sufficiency
 - Dagatan Lake in Quezon Province is a small lake with a surface area of about 7.0 ha but almost totally covered by thick aquatic vegetation and thus requires rehabilitation
 - the importance of mobilizing local communities is necessary, especially in resource rehabilitation activities, i.e. removal of aquatic plants that pose serious problems on the conservation of indigenous fish species, and promotion of economic activities
 - for successful implementation of rehabilitation activities, there is a need to harmonize legal and juridical mandate, enhance the management skills of fisherfolk, ensure sufficient supply of fingerlings, make rehabilitation sites accessible, and conserve indigenous species

Thailand

- **Artificial reefs installation**
 - installation of artificial reefs in Pattani and Narathiwat Provinces from 2002 to 2015 under the Royal Initiative Project, made use of five (5) types of materials, namely: concrete pipes, concrete blocks, abandoned train cars, used military tanks, and used cars
 - results from monitoring the artificial reefs and fishing gear operations, and income of fishers from fishing around the artificial reefs indicated that most artificial reefs are still in good condition although some are observed to be sinking, while a total of 188 fish species inhabit the artificial reef areas
 - hook and line, threadfin bream fish trap, fish trap, and short-bodied mackerel gill net have been used by small-scale fishers in their fishing operations around the artificial reefs
 - income survey suggested that the total income of fishers ranged from 14,275.38 to 110,064.71 Baht/month and catch rate of about 31.045 kg/boat while the average income was 47,371.20 Baht/month
 - the project has succeeded in raising the standards of living of fishers and in restoring the natural wealth of the fishery resources
- **Management of fisheries refugia**
 - fisheries *refugia* has been established in the Gulf of Thailand for Indo-Pacific mackerel (*Rastrelliger brachysoma*) and other economically important species that face major stock reduction due to various factors, i.e. increasing demand for protein sources together with rapid development and improvement of fishing gear and fishing techniques, and illegal fishing, among others
 - enforcement of closed seasons and areas in some parts of the Gulf of Thailand for Indo-Pacific mackerel (*Rastrelliger brachysoma*) and other economically important species has been carried out
 - measures involve prohibiting the operation of some fishing gears and practices as well as monitoring changes in the status of the target species and evaluating the fishing methods to determine the appropriate measures that could be promoted from time to time for the sustainable utilization of such pelagic species
 - measures developed for conserving the Indo-Pacific mackerel had been used as basis for the formulation and development of conservation measures for other economically-important aquatic commodities
 - cancellations and revisions of the measures are effected from time to time based on the changes in the status of the fishery resources and effective management of the aquatic resources
- **Restocking and stock restoration**
 - restocking programs had been implemented in the country through the Department of Fisheries (DOF), local administration organizations, provincial agencies, the Electricity Generating Authority of Thailand and other private sector, and government agencies
 - in aquatic animal stocking, achievements depend on participation of local communities
 - new Management Strategies of Thailand adopted starting in 2015 is an important tool that could be used to attain sustainable production from fisheries and maintain fish diversity, as well as means to enforce relevant laws and regulations to combat illegal fishing in the country
 - the Strategy effective in enforcing control measures as determined from the catch although production could vary depending on the environments
 - the natural stock of giant clam species *Tridacna squamosa* has been declining in their natural distribution area, therefore hatchery breeding and seed production of the giant clam had been carried out in Thai waters since 1993 mainly for conservation purposes
 - results of the trial restoration of giant clam attained a survival rate of 40% mainly influenced by various factors that affect the environment
 - restoration of giant clam made use of metal netted cages to protect the stocks from predators and illegal collection

Box 1. Initiatives of the ASEAN-SEAFDEC Member Countries on fishery resources enhancement (Cont'd)

Viet Nam

- **Management of fisheries refugia and MPA systems**
 - country promotes closed seasons and areas as useful measures for promoting stock enhancement, especially for endemic, rare and important economic aquatic species, e.g. tiger shrimp (*Penaeus monodon*), featherback (*Notopterus notopterus*), ray-finned carp (*Semilabeo notabilis*), spiny barb (*Spinibarichthys denticulatus*), redbtail catfish (*Hamibagrus elongatus*), common carp (*Cyprinus carpio*), barbel chub (*Squaliobarbus curriculus*)
 - country's MPAs system has been playing an important role in stock enhancement, serving as potential successful approach in addressing barriers in fish stock and habitat management
 - results of activities could serve as important measure for enhancing the fishery stocks allowing them to continue providing animal protein, employment and household income for rural people
 - monitoring of the country's MPAs systems is done once a year, the results of which are used as basis in formulating policies and regulations on the protection and development of the aquatic resources
 - engagement of stakeholders during the process of establishment the conservation zones should be ensured considering the knowledge and experience of local stakeholders, e.g. officers, fishers, scientists, and government authorities
 - consultations with stakeholders should be regularly conducted to make them understand the MPA systems and the benefits that could be gained from the systems
- **Restocking and stock restoration**
 - artificial breeding of abalone (*Haliotis diversicolor*) has been carried out in Bach Long Vi (2012 - 2015), since the many-colored species of abalone (*Haliotis diversicolor*) is of high commercial value but the abalone stocks in the natural habitat had decreased due to over-exploitation
 - to restore the natural abalone resources, artificial breeding had been carried out producing 1,250,000-2,000,000 larvae and 137,960 juveniles (6.4-17.3 mm length) with survival rate of 6.9-11.0%
 - about 6,000 juveniles (1 cm length) were released in Bach Long Vi National Marine Protected Area in 2014 for conservation, and after one year, the abalones were found to have attained an average shell length of 3.4 cm

SEAFDEC

- **Management of artificial reefs**
 - pilot project was conducted by SEAFDEC/TD to evaluate the impacts of enhancement practices including ARs, on the fishery resources and the environment in Rayong Province of Thailand in 2009-2014 in collaboration with the Eastern Marine Fisheries Research and Development Center (EMDEC) of Rayong
 - activities included identification of fishing gear used as well as species composition and abundance, and underwater observation to assess the condition of the ARs
 - in the case of Rayong ARs, fishery resources around ARs appeared to be less enhanced due to certain environmental problems, such as the accidental crude oil leak from the PTT Global Chemical pipelines off the coast of Rayong Bay which could have created a massive impact to the environmental condition
 - as a result, in the ARs area in adjoining Ban Phe Bay, there was massive reduction of the fishery resources around the Bay
 - a study on the water circulation in the Bay suggested insufficient water exchange in the ARs areas due to a blockage of the shore tidal current flow
 - future studies on the impacts of artificial reefs installation on the environmental conditions would consider primary productivity, suspended solids, water turbulence, characteristics of bottom sediments, and marine benthos
 - monitoring of the ARs areas should be carried out four (4) times in a year, i.e. before and after monsoon seasons, to compare the results obtained considering the different sea conditions of the ARs areas
- **Management of fisheries refugia and MPA systems**
 - the ASEAN-SEAFDEC Ministers responsible for fisheries support the promotion of the fisheries refugia approach in the Southeast Asian region by endorsing the ASEAN-SEAFDEC Regional Guidelines on the Use of Fisheries Refugia for Capture Fisheries Management in Southeast Asia in 2006, and adopting the 2011 ASEAN-SEAFDEC Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020 which serves as guide in formulating and implementing programs and activities that promote the adoption and use of the refugia concept in line with the aforesaid ASEAN-SEAFDEC Regional Guidelines
- **Habitat diagnosis and restoration**
 - Studies had been carried out by SEAFDEC/TD on selection of critical fishing grounds in marine habitats, and promotion of conservation and rehabilitation measures
 - a deteriorated seagrass bed area in Sriboya Island, Krabi Province, Thailand was selected as one of the pilot sites to mitigate the area's depleted stocks of an edible sea snail, the dog conch (*Strombus canarium*)
 - dog conch is commonly harvested by fishers and local communities by hand and/or labor-saving equipment using motorized boats, dredges, and diving with self-contained underwater breathing apparatus but such massive collection methods of harvesting easily led to the drastic degradation of the seagrass bed habitats as well as deterioration of the dog conch population
 - SEAFDEC/TD, therefore promoted the conservation and optimum utilization of dog conch through public awareness activities
 - the Andaman Sea Province Dog Conch Shell Resource Management Measures had been formulated through consultations with local stakeholders in Krabi Province and nearby provinces
 - a consensus and subsequent implementation of several management schemes, such as restriction on dog conch harvestable size (less than 6 cm) and allowable type of fishing gear (dredges), as well as banning the use of motorized boats
 - several types of media that support awareness building, such as posters, stickers, brochures and banners were produced and distributed to several provinces along the Andaman Sea coast
 - permanent dog conch conservation areas were established by the local fishing communities at Sriboya Island in Krabi Province, and Muk Island in Trang Province
 - for the replantation of seagrass beds, collaboration is necessary with experts/researchers on seagrass to support such activities, especially on the evaluation of seagrass bed resources

Box 1. Initiatives of the ASEAN-SEAFDEC Member Countries on fishery resources enhancement (Cont'd)

- **Restocking and stock restoration**
 - stock enhancement activities had been carried out by SEAFDEC/AQD since 2001 with the first stock enhancement of mud crab (*Scylla* spp.) funded by the European Commission, and followed by another stock enhancement activities for seahorses (*Hippocampus* spp.), giant clam (*Tridacna* spp.), abalone (*Haliotis asinina*), and sea cucumber (*Holothuria* spp.) as priority species with support from the Japanese Trust Fund
 - release strategies had been established for the giant clam, abalone, and mud crab
 - giant clams should be released in ocean nurseries until they reach escape size of 20 cm shell length (SL) for better survival before transferring seeds to shallow reefs with warm temperature for better growth
 - community-based stock enhancement of abalone *Haliotis asinina* in Sagay Marine Reserve in Negros Occidental (central Philippines) included social baseline surveys and establishment of a community-based stock enhancement demo-site accessible to and replicable by the fishers
 - involvement with strong engagement of the stakeholders led to communities' agreement in 2010 to regulate the catch size of abalone at 6 cm
 - involvement of the communities helped in the successful implementation of activities that deal with stock enhancing and restocking
 - appropriate release size of 2.5-3.5 cm based on research results was recommended since stocking bigger juveniles would entail higher investments in hatchery rearing
 - sincere collaboration is necessary to enhance the participation of stakeholders which could lead to successful project implementation
 - maintaining camaraderie with the stakeholders, establishing a good working team, conducting regular consultations with stakeholders and occasional meetings with concerned local government units, and intensifying information, education and communication (IEC) activities, among others are important factors in undertaking restocking activities
 - giving the stakeholders thorough independence is important, especially in carrying out the management responsibilities to make them recognize and take up ownership of any restocking activity
 - equal sharing of proceeds from the activities is also important for the livelihoods of the stakeholders, e.g. in the community-based stock enhancement of abalone, the fisherfolk organization developed their own sharing scheme, so that 30% of the proceeds go to the fisherfolk organization; 30% to the fisherfolk (to be equally shared); 30% to the administration of Sagay Marine Reserve; and the remaining 10% to fund other operating expenses
 - for abalone, seeds should be released at ≥ 3 ml SL and should be transported from the hatcheries using PVC transportation modules to minimize mortalities caused by transport stress
 - for mud crab there is a need to check the conditions of release areas at least one month prior to release to increase the chances of survival in the wild
 - regular monitoring the released stocks is crucial as observed in releasing the mud crab, where the crablets appeared lost in the wild
 - tagging the stocks is also necessary to separate the released stocks from wild conspecifics, and that appropriate tags should be chosen, e.g. diet tags have been used in the case of abalone, numbered dymatapes for giant clams, and coded microwires for mud crabs
 - stock enhancement of the tiger shrimp (*Penaeus monodon*) in New Washington Estuary (NWE) in the Province of Aklan in central Philippines was carried out with support from the Research Institute for Humanity and Nature (RIHN) of Japan
 - impacts of the tiger shrimp stock enhancement included increased income of fishers, reduced number of fishing gear, mangroves rehabilitation promoted, and methods for implementation the tiger shrimps stock enhancement established considering the biological, technical and socio-economic aspects
 - results after the stock enhancement activity in that area indicated increased incomes by 300%

Box 2. Policy Recommendations and Strategic Plans for Fisheries Resources Enhancement in the Southeast Asian Region adopted during the July 2015 Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region

I. Fishery Resources Enhancement through Habitat Improvement and Management

Issues/Challenges	Recommendations	Strategic Plans
Artificial Reefs Management	<ul style="list-style-type: none"> • Best practices on installation of artificial reefs (ARs) should be promoted to ensure the protection of aquatic species during their life cycle and allowing them to reach optimum size. • Planning and deployment of ARs should be undertaken, taking into consideration the following: <ul style="list-style-type: none"> - Clear purpose of ARs, e.g. resources enhancement; - Results from relevant feasibility studies, including cost-benefit analysis, socio-economic analysis, financial analysis, among others; - Involvement of researchers, policy makers, fishing communities, local government units and other stakeholders in the planning process; - Results of site suitability evaluation, e.g. existing corals/fishes, seabed conditions, oceanographic conditions, water circulation patterns; - Choice of AR design(s) that should suit seabed conditions and purpose; and - Certainty that installed ARs does not create pollution to the marine environment. 	<ul style="list-style-type: none"> • Developing Regional Guidelines on Best Practices for Installation of the Artificial Reefs (ARs)

Box 2. Policy Recommendations and Strategic Plans for Fisheries Resources Enhancement in the Southeast Asian Region adopted during the July 2015 Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region (Cont'd)

Issues/Challenges	Recommendations	Strategic Plans
	<ul style="list-style-type: none"> • ARs should be regularly monitored (over time, and seasonally) using appropriate parameters, e.g. conditions of ARs, primary productivity, abundance and diversity of aquatic species (fish, macro benthos, etc.). The impacts of ARs on environmental conditions, e.g. water current, turbidity, and sedimentation, among others, should also be monitored. • Regular monitoring and evaluation of the effectiveness of AR programs should be conducted (for short-, medium- and long-term) by comparing various indicators before/after or within/ outside ARs. Correlation of the abundance of species inhabiting the ARs and other environmental factors, e.g. bottom condition, water current/condition, should also be established. • Cost-benefit analysis of AR deployment program(s) should be conducted, taking into consideration the resources, environmental and socio-economic benefits that could be gained from the program(s). Data to be collected could include investment costs (ARs construction and deployment), fisheries production by fishing gear and fishers' incomes before and after ARs deployment, and other ecosystem services. • Implementation of AR program(s) should be integrated with other fisheries management measures, e.g. fishing regulations that include among others, prohibition of encroachment of commercial fishing activities, establishment of conservation/fishing zones, to ensure that resources are utilized in sustainable manner. Stakeholders' consultations on the management of ARs should be conducted to elaborate responsibility of stakeholders and fishers in the management plan. • AR programs could be implemented in the coastal and offshore (if necessary) areas to ensure that the life cycle of both of demersal and pelagic species is sustained. • A list of expertise on ARs and available resources should be compiled for reference and usage by the countries. 	<ul style="list-style-type: none"> • Integrating fisheries management measures/ principles in AR management programs • Integrating ARs in policies and plans for coastal and offshore fisheries resources conservation, management and development
Integrating Fisheries and Habitat Management	<ul style="list-style-type: none"> • Fisheries <i>refugia</i> could be implemented to complement the existing conservation/management measures, by integrating it with the fisheries objectives of protecting critical life cycle, e.g. spawning, nursing, broodstock aggregation, and migratory routes of species targeted for management. • Selection of site(s) for fisheries <i>refugia</i> should be based on scientific information and local knowledge especially in identifying the areas that are natural habitats for critical stages of the life cycle of species targeted for management, e.g. spawning, nursery grounds, broodstock aggregation, migratory routes. The area of the Fisheries <i>Refugia</i> should be manageable by concerned stakeholders. • Regulations on fishing activities in the <i>refugia</i> (e.g. restriction of harvestable size, fishing seasons, fishing gears/methods) should be enforced taking into account up-to-date scientific data (e.g. spawning season, size at maturity, larval study), which should be relevant and correspond to the activities of host communities. • Community participation should be optimized for the establishment and management of fisheries <i>refugia</i> (e.g. identification of suitable sites, establishment/implementation of management measures including MCS) and collaboration with relevant government agencies at local/national levels should be strengthened so that the fisheries <i>refugia</i> could be as self-sustaining as possible. • Sub-regional cooperation should be strengthened for the establishment of fisheries <i>refugia</i> for management of trans-boundary species (e.g. Indo-pacific mackerels) that move across the EEZs of more than one country. 	<ul style="list-style-type: none"> • Promoting the establishment of fisheries <i>refugia</i> as a tool for integrating fisheries and habitat management • Conducting scientific research programs and stakeholders consultation to support the identification of suitable sites and establishment of fisheries <i>refugia</i> for target species, and coming up with scientific evidence that harmonize with local knowledge to serve as basis for developing appropriate management measures • Ensuring the sustained participation of key stakeholders in the planning, sites selection and development of management measures for fisheries <i>refugia</i>. • Enhancing regional and sub-regional collaboration for the establishment of fisheries <i>refugia</i> system for transboundary fish stocks management

Box 2. Policy Recommendations and Strategic Plans for Fisheries Resources Enhancement in the Southeast Asian Region adopted during the July 2015 Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region (Cont'd)

Issues/Challenges	Recommendations	Strategic Plans
<p>Degradation of (fish) habitats in the Southeast Asian region</p>	<ul style="list-style-type: none"> • Fish habitat restoration priorities in different water resources in the region should be reviewed. • Effectiveness of habitat restorations and resources enhancement in inland water resources such as lakes should be determined through the following methodologies: <ul style="list-style-type: none"> - Conduct of baseline studies; - Harmonization of legal and juridical mandates of authorized agencies, including local governments responsible for water resources; - Pooling of government funds and resources; - Mobilization of local communities and/or other stakeholders; - Application of technical tools to reconstruct the fisheries; and - Improvement of buffer zones. • Habitat restoration should be implemented through suitable co-management arrangements taking into consideration the importance of the ecosystem. • The “Satoumi Concept” could be considered as one of the Integrated Coastal Management approaches for habitat restoration. <p>Remarks: Developed by Japan, the “Satoumi Concept” is a form of unified management system for land and sea, where management mechanisms for coastal waters move inland, one step away from integrated coastal management so that land and sea are brought under a unified management policy. In short, the “Satoumi Concept” is meant for environmental conservation of coastal areas in harmony with human interaction on land.</p> • Enhancement of fish populations in restored habitats could be carried out by applying appropriate techniques such as installation of ARs, establishment of fisheries <i>refugia</i>, restocking, and/or mangrove reforestation, etc. • Since indigenous knowledge is crucial for habitat restorations, applicable only in most cases for specific areas and the culture of local communities, science and indigenous knowledge should be combined to ensure the effectiveness of habitat restorations. • Impact assessment of lost natural habitats (<i>i.e.</i> coral reefs, sea grass and sea beds) due to human activities (irresponsible fishing or pollution) should be conducted as well as raising the awareness of stakeholders on the importance of habitats to humans and fishes. 	<ul style="list-style-type: none"> • Making habitat restoration a priority at national levels • Developing the best practice guidelines on habitat restoration for different water resources such as inland and marine, in conjunction with fisheries resources enhancement programs. • Rebuilding sustainable fish populations in restored habitats • Undertaking baseline studies based on indigenous and scientific knowledge • Conducting impact assessment of lost natural habitats, and raising the awareness of stakeholders on conservation and protection of the natural habitats

II. Fishery Resources Enhancement through Artificial Propagation and Stock Release

Potentials and Limitations of Stock Enhancement and Restocking

<ul style="list-style-type: none"> • Selection of species and release area considerations <ul style="list-style-type: none"> - Lack of species and site specific protocols/guidelines for successful stock enhancement/restocking - Techniques (specific to stock enhancement) for ex-ante impact assessment and monitoring (biological, environmental, social and economic) are not available 	<ul style="list-style-type: none"> • Stock enhancement and restocking activities should take into consideration the following: <ul style="list-style-type: none"> - Development of species- and site-specific strategies to ensure success of activity; - Give high importance to availability of scientific information/biology of the target species; - Ensure appropriate choice of species - benthic over pelagic and migratory species; - Provide adequate preparation/rehabilitation of receiving habitats to ensure likelihood of success; and - Give preference to marine reserves as release sites for managed monitoring and harvesting. 	<ul style="list-style-type: none"> • Developing Regional Guidelines or criteria for feasibility assessment and improvement and disseminating the Guidelines to Member Countries <p>[Note: the Guidelines will take into considerations the elements for higher success of restocking and stock enhancement covering the technical (choice of species, biology/life cycle of species, sustainable supply of quality seeds/stocks), environmental (suitability of site), social/institutional (involvement and strong support of local communities, local government agencies and research institutions), and economic aspects (funds)].</p> • Formulating a ‘Strategy or Framework for Sustainability of Stock Enhancement Initiatives’ and disseminating this Framework to Member Countries
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Box 2. Policy Recommendations and Strategic Plans for Fisheries Resources Enhancement in the Southeast Asian Region adopted during the July 2015 Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region (Cont'd)

Issues/Challenges	Recommendations	Strategic Plans
<ul style="list-style-type: none"> • Strategy to ensure sustainability of activities and gains/benefits achieved from stock enhancement is not yet developed • Although benefits from stock enhancement and restocking are urgently needed and appreciated, the technical capabilities and financial resources of most Member Countries could be limited 	<ul style="list-style-type: none"> • Active involvement of the local people (especially the fisherfolks) in the planning, implementation and monitoring activities, with understanding that the objectives of the activity and its long-term sustainability will largely depend on their continuous active involvement and participation; • Well-defined governance arrangements, and access and harvest rights through consultations with various stakeholders in enhancement/restocking activities; • Conduct of cost-benefit analysis of release and stock enhancement activities; • Implementation of long-term planning with all stakeholders to ensure availability of sufficient funds and manpower resources; • Participation of the local government units and their assured commitment to adopt and sustain stock enhancement initiatives (with donor funds) beyond project completion date; • Creation of supplemental and alternative livelihood strategies to encourage fisherfolks' participation and compliance to regulations; • Promotion of multi-stakeholder involvement and embedding conflict management in all phases of stock enhancement activity (including planning for and prioritizing a bottom-up approach in policy & regulation formulation); • Implementation of regulations and networking with enforcement agencies for protection of released stocks and management of recaptures; and • Implementation of activities, in conjunction with other management and conservation measures, to ensure that resources are utilized in sustainable manner. 	
Release Strategies and Ecological Interaction with Natural Stocks		
<ul style="list-style-type: none"> • Lack of release protocols/guidelines (specific to stock enhancement) • Capacity of Member Countries on ecological risk assessment and effective monitoring needs to be assessed and strengthened 	<ul style="list-style-type: none"> • Assess the initial status of the community structure of the release site and monitor over time to determine the effects of interaction with the released stocks. • Determine the appropriate size of release of stocks to ensure high survival, avoidance of predators and economic efficiency. • Conduct proper behavioral conditioning of stocks prior to release. • Promote regular and long-term continuous monitoring to determine effectiveness. • Develop effective marking techniques for stock enhancement <ul style="list-style-type: none"> - Determine appropriate tags for proper identification of released stocks and for effective long-term monitoring. • Based on needs of Member Countries, enhance their capacity on the application of decision-making tools for stock release (e.g. ecological risk assessment tool). 	<ul style="list-style-type: none"> • Establishing release protocols/guidelines based on scientific findings and in accordance with existing policy instruments/regulations • Implementing effective institutional frameworks, policy instruments for the release of stocks, monitoring and enforcement mechanisms at national and local levels • Developing and implementing capacity building programs on the application of decision-making tools for stock release
Aquaculture-based Enhancement and Restoration		
<ul style="list-style-type: none"> • Genetic, health and biodiversity considerations <ul style="list-style-type: none"> - Indiscriminate stocking or translocation of non-indigenous species/stocks poses adverse genetic and health risks 	<ul style="list-style-type: none"> • Importance of the genetic and health information of species should be well recognized to minimize genetic effects, transfer of diseases and protect biodiversity. 	<ul style="list-style-type: none"> • Formulating mechanism that will ensure that stocks for release are healthy/disease-free (for instance, thru health certification) and will not pose genetic risks • Strengthening IEC (information, education and communication) activities to enhance public awareness on genetic and health risks related to stock release and the need for precautionary measures following relevant Guidelines developed and promoted by FAO

Box 2. Policy Recommendations and Strategic Plans for Fisheries Resources Enhancement in the Southeast Asian Region adopted during the July 2015 Symposium on Strategy for Fisheries Resources Enhancement in the Southeast Asian Region (Cont'd)

Issues/Challenges	Recommendations	Strategic Plans
<ul style="list-style-type: none"> Lack of seed production techniques and facilities intended for enhancement and restocking activities 	<ul style="list-style-type: none"> Increase government investments and solicit donor contributions for aquaculture R&D and related facilities to support wide-scale and high-impact stock enhancement and restocking initiatives 	<ul style="list-style-type: none"> Fostering strong collaboration among R&D institutions, national and local government, and local communities on initiatives that will support wide-scale and high-impact stock enhancement and restocking initiatives

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About the Authors

Dr. Yuttana Theparoonrat is the Head of Coastal and Small-scale Fisheries Management Division of SEAFDEC Training Department, Samut Prakan, Thailand.

Mr. Hajime Kawamura was the Deputy Secretary-General of SEAFDEC and Deputy Chief of SEAFDEC Training Department from April 2013 until April 2016. Starting May 2016, he recommenced his work with the Fisheries Agency of Japan (FAJ) in Tokyo, Japan where he used to work before his stint with SEAFDEC.

Ms. Virgilia T. Sulit is the Managing Editor of *Fish for the People* based at SEAFDEC Secretariat in Bangkok, Thailand.

Dr. Nopporn Manajit is a Fisheries Resources Enhancement Scientist based at SEAFDEC Training Department, Samut Prakan, Thailand.