Overview of Current Status and Trends of Fisheries and Issues on Resources Enhancement in Southeast Asia

Somboon Siriraksophon
Policy and Program Coordinator
email: somboon@seafdec.org

Suwanee Sayan
Policy and Program Officer
SEAFDEC Secretariat, Bangkok, Thailand

Abstract

This paper is prepared for the Symposium on Strategy for Fisheries Resources Enhancement with the objective of providing an overview of the current status and trends of fisheries in the Southeast Asian region as well as reviewing the activities on enhancement of fisheries resources within the EEZs of SEAFDEC Member Countries for discussion during the development of the Regional Strategies or Approaches on fisheries resources conservation and rehabilitation. Considering the need to address issues on fisheries resources enhancement as stipulated in the 2001 and 2011 ASEAN-SEAFDEC Resolutions and Plans of Action, several programs under the ASEAN-SEAFDEC Strategic Partnership (ASSP) have been implemented since 2003 at national and regional levels to enhance the countries' respective fishery resources. The constraints and challenges are discussed and summarized in this paper for consideration in the overall effort towards achieving sustainable fisheries in the region.

OVERVEW OF THE STATUS AND TRENDS OF FISHERIES

Global Production of Fish

Fish and fishery products are among the most important agricultural commodities providing significant contribution to the world's food security and economic development. Out of the total value of the global agricultural products reported at US$ 1,168.85 billion in 2009, fish and fishery products accounted for US$ 90.73 billion or about 8% of the total value (WTO, 2010). Aside from its contribution to the world's economies, fish and fishery products are also important source of protein for people worldwide and represent a significant part of the diets of peoples in many countries. From 2000 to 2012, the global fishery production had continuously increased from about 131.0 million metric tons (MT) to 158.0 million MT (**Table 1**) while the percentage of the production for human consumption also gradually rose from almost 74% to 86%. It should be noted however that the increasing trend in total fishery production is mainly due to the increasing contribution from the aquaculture sector, while production from capture fisheries has gradually been declining.

With the world's population increasing from 6.1 billion to 7.1 billion over the same period, the per capita fish consumption has also escalated. This trend is expected to continue to rise particularly in the developing countries where the population and demand for food are continuously growing because of increased income and purchasing power for high-value and quality food including food fish. In addition, the fishery sector with its ancillary activities which had expanded with increased numbers of people employed, significantly contributes to improved livelihoods and employment opportunities, as well as to the enhanced well-being of millions of peoples including those in the Southeast Asian region.

In terms of fishery statistics for both capture fisheries and aquaculture, fishery production of the countries in the Southeast Asian region is reported under FAO Fishing Area 57 (Indian Ocean, Eastern), 71 (Pacific, Western Central), 61 (Pacific, Northwest), and 04 (Asia, Inland Waters). Based on such arrangement, the total fishery production of the Southeast Asian region from 2000 to 2009 compiled by SEAFDEC from inputs of the countries and published in the Fishery Statistical Bulletin for the South China Sea Area 2000-2007 and the Fishery Statistical Bulletin of Southeast Asia 2008-2012 is summarized in **Table 2**.

From 2000 to 2012, the regional fishery production had continuously increased from about 17.0 million MT to 39.6 million MT. Among the Southeast Asian countries, Indonesia, Myanmar and Viet Nam showed gradually increasing trends in their total fisheries production.

Table 1. World's fishery production and utilization from 2000 to 2012

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Production													
INLAND													
Capture	8.8	8.9	8.8	9.0	8.6	9.4	9.8	10.0	10.2	10.1	11.3	11.1	11.6
Aquaculture	21.2	22.5	23.9	25.4	25.2	26.8	28.7	30.7	32.9	35.0	77.8	82.6	79.7
Total Inland	**30.0**	**31.4**	**32.7**	**34.4**	**33.8**	**36.2**	**38.5**	**40.7**	**43.1**	**45.1**	**89.1**	**93.7**	**91.3**
MARINE													
Capture	86.8	84.2	84.5	81.5	83.8	82.7	80.0	79.9	79.5	79.9	36.8	38.7	41.9
Aquaculture	14.3	15.4	16.5	17.3	16.7	17.5	18.6	19.2	19.7	20.1	22.3	23.3	24.7
Total Marine	**101.1**	**99.6**	**101.0**	**98.8**	**100.5**	**100.2**	**98.6**	**99.1**	**99.2**	**100.0**	**59.1**	**62.0**	**66.6**
TOTAL CAPTURE	95.6	93.1	93.3	90.5	92.4	92.1	89.8	89.9	89.7	90.0	48.1	49.8	53.5
TOTAL AQUACULTURE	35.5	37.9	40.4	42.7	41.9	44.3	47.3	49.9	52.6	55.1	100.1	105.9	104.4
TOTAL WORLD FISHERIES	**131.1**	**131.0**	**133.7**	**133.2**	**134.3**	**136.4**	**137.1**	**139.8**	**142.3**	**145.1**	**148.2**	**155.7**	**157.9**
Utilization													
Human consumption	96.9	99.7	100.2	102.7	104.4	107.3	110.7	112.7	115.1	117.8	128.2	131.2	136.2
Non-food uses	34.2	31.3	33.5	30.5	29.8	29.1	26.3	27.1	27.2	27.3	19.9	24.5	21.7
Population(billions)	6.1	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.8	6.9	7.0	7.1
% of production for human consumption (%)	73.9	76.1	74.9	77.1	77.8	78.7	80.8	80.6	80.9	81.2	86.6	84.3	86.3
Per capita food fish supply (kg)	**15.9**	**16.2**	**16.2**	**16.3**	**16.2**	**16.5**	**16.8**	**16.9**	**17.1**	**17.2**	**18.5**	**18.7**	**19.2**

Source: FAO State of World Fisheries and Aquaculture 2004, 2010 and 2014

Table 2. Total fishery production of the Southeast Asian countries from 2000 to 2012 (MT)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brunei Darussalam	2,577	1,575	2,215	2,160	3,133	3,103	3,100	3,227	2,747	2,418	2,772	2,447	5,079
Cambodia	298,798	411,200	424,432	390,657	343,492	546,000	661,542	525,100	536,320	515,000	550,000	631,695	728,000
Indonesia	5,120,490	5,409,504	5,515,648	5,915,989	6,005,622	6,646,965	7,183,586	7,510,767	9,054,873	10,064,140	11,662,311	13,626,141	18,763,893
Lao PDR	71,000	81,000	93,000	95,000	95,000	107,800	107,800	91,660	93,500	105,000	113,000	129,600	136,000
Malaysia	1,457,139	1,411,740	1,467,486	1,483,957	1,537,988	1,421,403	1,644,527	1,654,221	1,639,008	1,729,002	1,806,577	1,665,842	1,760,840
Myanmar	1,309,830	1,474,460	1,606,240	1,987,020	2,148,580	2,581,780	2,817,990	2,808,037	3,147,605	3,491,103	3,901,979	4,149,799	4,417,676
Philippines	2,993,332	3,166,528	3,369,524	3,619,282	3,926,173	4,161,870	4,408,472	4,711,252	4,964,703	5,084,674	5,155,647	4,973,588	4,865,678
Singapore	9,984	7,784	7,795	7,109	7,579	7,837	11,675	8,026	5,141	5,687	5,233	5,592	5,546
Thailand	3,713,248	3,648,429	3,797,014	3,914,025	4,137,066	4,132,826	4,051,824	3,675,382	3,204,200	3,137,672	3,113,316	2,870,085	3,068,345
Viet Nam	1,961,145	2,009,623	2,647,407	2,859,200	2,944,030	3,397,200	3,656,152	4,315,500	4,559,720	4,782,400	5,127,600	5,432,900	5,816,100
Total	16,937,543	17,621,843	18,930,761	20,274,399	21,148,663	23,006,784	24,546,668	25,303,172	27,207,817	28,917,096	31,438,435	33,487,689	39,567,157

Source: Fishery Statistical Bulletin for the South China Sea Area 2000-2007
Fishery Statistical Bulletin of Southeast Asia 2008-2012

Fisheries production of the Southeast Asian region comes from three sub-sectors, namely: marine capture fisheries, inland capture fisheries, and aquaculture. **Table 3** shows the total fishery production of the region by sub-sector in 2012 and indicates that the largest portion of the production is derived from aquaculture accounting for approximately 53.5% followed by marine capture fisheries of about 39.5%, and inland fisheries 7.0%.

While aquaculture contributes the largest volume of production, its production value which accounts for 48% of the total production value only comes next to marine capture fisheries which contributes approximately 45% and that of inland capture fisheries of about 7%. While the value per metric ton of marine capture fisheries production was about US$ 1,286/MT that of aquaculture production was only about US$ 1,025/MT.

Table 3 Fishery production (quantity and value) of Southeast Asia by sub-sector in 2012

Sub-sector	Quantity (MT)	Value (US$ 1000)	Value (US$/MT)
Marine Capture Fisheries	15,590,704	20,049,002	1,286
Inland Capture Fisheries	2,819,963	3,226,605	1,144
Aquaculture	21,160,458	21,683,275	1,025
Total	**39,571,125**	**44,958,882**	**1,136**

Capture Fisheries Production in the Southeast Asian Region

Fisheries of the Southeast Asian region are by nature tropical, multispecies and multi-gears, and involve large numbers of fishers and farmers mostly engaged in small-scale fishing operations and aquaculture practices. Indonesia consistently attains the highest capture fisheries production from 2003 to 2012 with an average annual production increase of almost 1.3 million MT **(Fig. 1**). Thailand's production was second after Indonesia in 2003-2006, its production maintained at 2.8 million MT during the ten-year period until 2005.

After 2007, the country landed into the fifth place in terms of total fisheries production. Production of Thailand from capture fisheries decreased from 2005 until 2008 at an average rate of about 200,000 MT per year. After 2008 until 2012, capture fisheries production of Thailand maintained at 1.8 million MT. In contrast, fishery production of Myanmar has been increasing from 2003 to 2012, from rank number five in 2003 the country ranked second in 2012 by about 3.6 million MT.

For the Philippines, capture fisheries production slightly increased from 2003 until 2010 after which the production decreased to about 2.4 million MT in 2012. Specifically, Indonesia's increasing production from 14 major groups of marine species that include marine fishes nei (Osteichthyes), scad nei (*Decapterus* spp.), skipjack tuna (*Katsuwonus pelamis*), short mackerel (*Rastelliger brachysoma*), stelophorus anchovies (*Stelophorus* spp.), kawakawa (*Euthynnus affinis*), goldstripe sardinella (*Sardinella gibbosa*), yellowstripe scad (*Selaroides Leptolepis*), Bali sardinella (*Sardinella lemuru*), and frigate tuna (*Auxis thazard*) among others, had contributed to the country's overall increasing production trend. On the other hand, although production from marine capture fisheries of Myanmar and Viet Nam had not been classified by species, both countries recorded escalating production trend of marine fishes nei (Osteichthyes). For the Philippines, production of six major groups of marine species that include sardinellas nei (*Sardinella* spp.), skipjack tuna (*Katsuwonus pelamis*), scad nei (*Decapterus* spp.), yellowfin tuna (*Thunnus albacares*), frigate tuna (*Auxis thazard*), and bigeye scad (*Selar crumenophthalmus*) among others had escalated, contributing to the country's increasing production from marine capture fisheries.

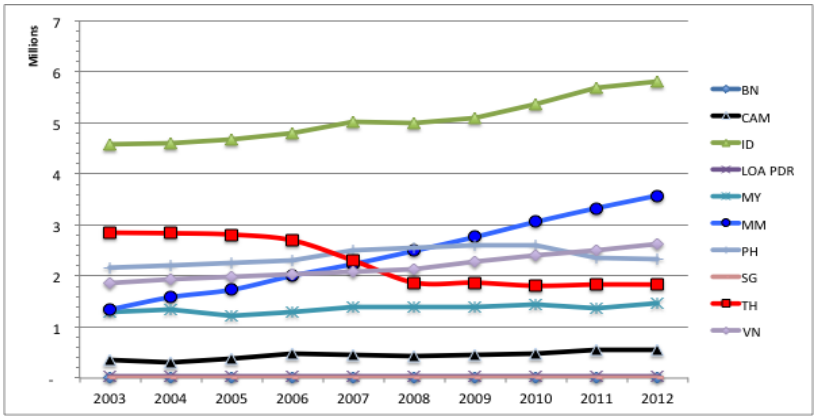

Fig. 1: Capture fishery production of the Southeast Asian region by country

STATUS AND TREND OF SOME ECONOMICALLY-IMPORTANT SPECIES

Based on preliminary analysis during 2000-2012 of the status and trend of some economically-important species, some findings are presented below:

Pelagic Fish Resources

The status and trend of production of five pelagic fish species in Southeast Asian countries during 1988-2012 are shown in **Fig. 2**. Skipjack tuna, scad nei, sardinellas nei, short mackerel and anchovies are the top five in the overall pelagic fish production. The same figure shows that during the past two decades, production trend of skipjack tuna and short mackerel gradually increased from 155,828 MT in 1988 to about 312,930 MT in 2012. Similar increasing trends were also found in skipjack and scad nei with production in 2012 at 711,403 and 666,558 MT, respectively.

For sardinellas nei, the production dramatically increased during 1988 to 1997, but fluctuated and decreased from about 500,000 MT in 1997 to about 367,887 MT in 2003 and after that it increased again to 567,880 MT in 2009. However, the production of sardinellas nei had decreased and maintained at about 400,000 MT in 2011.

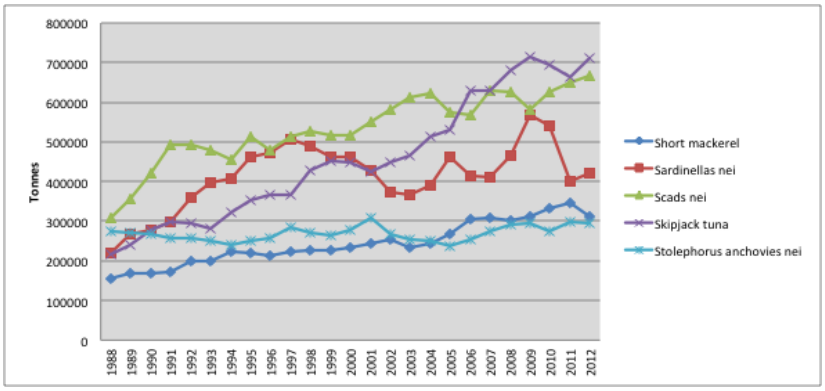

Fig. 2. Production from top five pelagic fishes in Southeast Asian countries

Demersal Fish Resources

Statistical data shows that the total production of demersal fish was one-third of the pelagic fish production during the last 20 years. Threadfin bream, ponyfishes, snappers, sea catfish, and bigeye nei were among the top five in the demersal fish production in this region. **Fig. 3** shows the trend of the top five demersal fish species in this region, indicating that only the snapper group tends to experience drastic increase in its production during the last decade from about 66,330 MT in 2002 to about 122,973 MT in the year 2012. The rest seems to have reached their maximum yield.

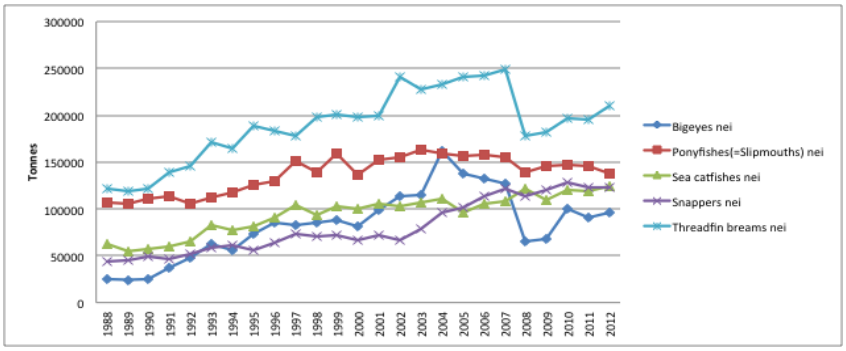

Fig. 3. Production from top five demersal fishes in Southeast Asian countries, 1988-2007

Resource Indicators

The status of the demersal resources focusing on economically-important species as surimi raw materials, was studied from bottom trawls in particular areas, *i.e.* Thailand, Cambodia, West Kalimantan of Indonesia, Brunei Darussalam waters and Malacca Strait (west coast of Peninsular Malaysia) from 2004 to 2007.

Results have indicated that the most abundant sea areas are the waters of Brunei Darussalam and West Kalimantan around the Natuna Islands where the CPUEs were 143.9 and 135 kg/hr, respectively. The water depths in both areas are more than 75 m and in some areas up to 110 m. For the Gulf of Thailand, the CPUEs ranged from 10 to 16 kg/hr only which were quite low compared with those of the other sea areas such as Malacca Strait (Yasook, 2008). Results of the joint study in different three areas (Stobutzki *et al*., 2006) showed serious declines in fishery resources in many areas that tend to continue if unsustainable fisheries and over-exploitation would still be practiced.

The study sites in Malaysia, Thailand and the Philippines showed declines in total biomass of demersal species. In Malaysia, the decline was greatest in shallow depths (<50 m) where the biomass declined to 4–20%.

In the Gulf of Thailand, the total biomass estimates had declined to less than 8%, and in the Philippines, changes in the biomass were examined and the recent estimates of the biomass were 12–64% of the original estimates. Severe declines in total biomass were thought to be due to over-fishing compounded by environmental degradation.

Exploitation ratios (fishing mortality: total mortality) calculated from length-frequency data, were on the average >0.5, suggesting that over-fishing occurs. Severe declines in fishery resources had also been observed in many areas and tend to continue if unsustainable fisheries and over-exploitation would still be practiced.

ENHANCEMENT OF FISHERIES RESOURCES IN THE SOUTHEAST ASIAN REGION

The declining fishery resources in both demersal and pelagic fishes in the coastal and offshore areas had created impacts to the fishing industries which had attained quick growth in the past two decades. This also pushed large numbers of fishing vessels to perform illegal fishing outside national jurisdictions or on the foreign exclusive economic zones and high seas. This led to big problems not only at the regional but also at global level.

Reduction of fishing capacity and improvement of fisheries management should therefore be implemented at national level. In addition, enhancing the fishery resources and fish stocks within the EEZs as a fishery management tool is needed to support the sustainable development of fisheries at the country level. Specifically, regional approach on this issue is necessary for trans-boundary pelagic species and shared stock species.

Southeast Asian Countries' Fisheries Resources Enhancement Programs

Many Southeast Asian countries have been concerned with declining resources, and thus had mainstreamed fishery resources enhancement programs in their respective national plans, policies and legislations, with the purpose of addressing the degradation of fishery resources.

Various tools have been used to alleviate the declining resources, while means of enhancing the habitats and controlling the utilization of resources have been undertaken, *e.g.* artificial reefs deployment, promotion of fishery *refugia* and marine protected areas (MPAs), use of fish aggregating devices (FADs), and installation of stationary fishing gears (SFGs).

❖ **Brunei Darussalam**

The Government through its Fisheries Department had developed and set up ARs since 1985 as means of promoting fishery resources enhancement using various types, *e.g.* used tires, steel pipes and prefabricated structures, and later on concrete prefabricated pyramidal structures. The ARs are used for protection and as barrier against illegal fishing gears. In 2003, two MPAs were developed in Selirong Island and Pelong Rocks, which had been integrated with the 8th National Development Plan (SEAFDEC, 2004 and 2005).

❖ **Cambodia**

In 1979, the Department of Fisheries established 13 protected areas called "fish sanctuaries" in freshwater zones especially in the Tonle Sap Great Lake. When the Fisheries Law was enforced in 1987, any fisheries activities were prohibited in the fish sanctuaries. In 1997, four national parks were established in coastal areas and part of the fifth park covering an area of 366,250 ha was considered as Protected Area.

Cambodia's Ministry of Environment and the Ministry of Agriculture, Forestry and Fisheries play significant roles in conducting the program in collaboration with many donors, *e.g.* the United Nations Environment Programme (UNEP), Danish International Development Agency (DANIDA), FAO, the Department for International Development (DFID) of UK. ARs program was initiated in 1991 using concrete modules and installed in the Tonle Sap Great Lake to provide habitats of aquatic species and improve fish stocks. In 2002, MPAs were established by the Fisheries Administration with funding support from ICRAND project under UNEP, in Koh Kong side of Sihanoukville where coral reefs are abundant (SEAFDEC, 2004 and 2005).

❖ **Indonesia**

In 1998, the Government launched a 15-year program (1998-2013) known as the Coral Reef Rehabilitation and Management Program (COREMAP) for the protection, rehabilitation and sustainable use of coral reefs and associated ecosystems through co-management. COREMAP covers 10 provinces including Maluku, Irian Jaya, South, Southeast, North Sulawesi, East and West Nusa Tenggara, Riau, and North and West Sumatra.

The major initiatives of Indonesia's COREMAP Phase 1 included public awareness campaigns, pilot community-based management, institutional development activities, and information and training network and development of a Monitoring, Control and Surveillance (MSC) system (UP-MSI, ABC, ARCBC, DENR, ASEAN, 2002).

❖ **Lao PDR**

Being landlocked, the country emphasizes only on inland fisheries. Several government development programs have been oriented towards clarification of boundaries and thereby enclosure of resources within fixed and legible territories. The country's Department of Livestock and Fisheries is responsible for the management of natural aquatic resources.

Between 1993 and 1999, the local government of Lao PDR endorsed the establishment of 68 Fish Conservation Zones as part of a community-based fisheries co-management initiative, all of which are situated in the mainstream Mekong River (Siphadone Wetlands) near the border of Cambodia. Besides government's support, communities also received support from international non-governmental organizations, especially for the Lao Community Fisheries and Dolphin Protection Project, and Environment Protection and Community Development (Baird, 2006).

❖ **Malaysia**

The country's primary policy relevant to the fisheries sector is its Third National Agricultural Policy (NAP3) governed by the Department of Fisheries Malaysia. In the 9th Malaysia Plan (1995-2010), the country's marine fish production was targeted at 1.32 million MT by maintaining the fish catch from coastal areas at the maximum quantity of 938,000 MT and increasing offshore catches to 382,000 MT.

In order to achieve the objectives, rehabilitation of resources through establishment of artificial reefs (ARs) and coral replanting programs are among the tools adopted in Malaysia. Meanwhile, fish aggregating devices (FADs) and ARs which have been found acceptable for fishery resources enhancement and management tools were also installed in the country's waters. As a result, a total of 99 ARs have been deployed since 1975 then later, more than 200 ARs have also been installed to mitigate the impacts and loss of habitats due to destruction and to increase the marine resources.

MPAs were first established in Malaysia in 1983 and promoted as no-take zones. At present, a total of 40 marine parks have been gazetted. FAD sites have been developed at the same time with MPAs, and a total of 222 FAD sites were established utilizing a budget of RM 24 million (SEAFDEC, 2004).

❖ **Myanmar**

The Ministry of Livestock and Fisheries is responsible for the fisheries development of the country. Marine parks and marine reserves as well as fisheries protected areas have been established under its Fisheries Law. Fishing in fisheries protected areas is prohibited unless specifically licensed to do so. ARs deployment and coral planting have not yet been established. Although the Department of Fisheries of Myanmar also recognizes the advantages of installing ARs, it is more concerned in increasing the number of marine parks and marine reserves or Marine Protected Areas at places where corals are abundant to restore and enhance the marine aquatic resources (SEAFDEC, 2004 and 2005).

❖ **Philippines**

The country's Fisheries Code of 1998 provides specific management measures to conserve and manage the fisheries resources of the country. ARs have been deployed by the Bureau of Fisheries and Aquatic Resources (BFAR) and technically supported the Local Government Units (LGUs). BFAR formed the SCUBA divers group to monitor, manage and safeguard the coral reefs. Initially, the group implemented the Coral Garden and Reef Rehabilitation Project in Tangalan, Aklan in central Philippines (SEAFDEC, 2004), and to date, there are over 500 MPAs around the Philippines. Established through local community initiatives in the entire Philippine coastline, these MPAs are locally managed marine areas entirely for artisanal (small-scale commercial) fishing activities (UP-MSI, ABC, ARCBC, DENR, ASEAN, 2002).

❖ **Singapore**

The Primary Production Department (now the Agri-Food and Veterinary Authority) launched a 10-year stocking program in 1986. Over 80,000 sea bass, 8,500 cherry snappers and 630,000 banana shrimps were released in the country's rivers basically promoting re-stocking and game fishing. ARs were installed in mid 1989s in the southern islands under the ASEAN-US Coastal Resources Management Project. In 2001, the National University of Singapore and Singapore Tourism Board conducted collaborative research on the use of ARs as a tourism sites. Nevertheless, Marine Protected Areas have no place elsewhere in the country so these are not included in the national policies on coral reefs of government agencies responsible for this resource. FADs were however installed to serve as obstacles in waterways but consequently, there was lack of interest in this aspect (SEAFDEC, 2004).

❖ **Thailand**

Since 1978, the Department of Fisheries (DOF) as the main agency responsible in governing fishery resources had been installing ARs for resource rehabilitation both in the Gulf of Thailand and Andaman Sea. From 1978 to 1986, DOF experimented on the substance, structure and techniques for deploying ARs.

The DOF of Thailand had established that the most suitable structure of ARs is the square concrete tube as these could also provide shelter for aquatic species, and obstruct trawlers and push netters from entering the AR areas. From 1986 until the present, 280 sites had been installed with small ARs, while 30 sites for large ARs were installed during 1988-2006 with funding of about one billion Baht. At present, local fishers can request installation of ARs from local authorities (Supongpan, 2006).

The Master Plan for Marine Fisheries Management of Thailand serves as guide for sustainable management of marine fisheries resources, and includes a 10-year plan starting in 2009 to "promote sustainable fisheries development based on the sufficiency economy that places the people at the center". The DOF has the main responsibility of encouraging related agencies and stakeholders to be involved in the plan. Included in Strategy 4 on ecosystem and fishing ground rehabilitation to safeguard biodiversity and marine environmental quality and to demonstrate the importance of resource enhancement, are several guidelines.

The guidelines under Strategy 4 of the Master Plan for Marine Fisheries Management of Thailand include: identification of natural habitats on which important fish stocks depend in certain parts of their lifecycle to ensure sizeable recruitment to fishable stocks; establishment of artificial reefs ARs and promotion of the use of living resources surrounding them under the management by community or fishermen organization; and promotion of sea ranching practices that do not jeopardize the marine ecosystem (DOF, 2008).

❖ **Viet Nam**

National activities on ARs are still being implemented and no ARs are yet in place (SEAFDEC, 2004). Development of the country's MPAs is governed by the Ministry of Science, Technology & Environment (MoSTE); Department of Fisheries Resources Protection, Ministry of Fisheries (MoFi); and Ministry of Forestry. Recently, the Government of Viet Nam authorized MoFi to develop a National Plan for Marine Protected Areas with marine components, particularly coral reefs and sea grass beds, and also includes marine protected areas in the Spratly's archipelago. However, the plan is still pending government's approval. MoFi will be responsible for the MPAs with the objective of conserving mainly the coral reefs, sea grass beds, island ecosystems and marine living resources (UP-MSI, ABC, ARCBC, DENR, ASEAN, 2002).

Country Synthesis on Overview of Resources Enhancement

The Workshop on Enhancing Coastal Resources: Artificial Reefs, Stationary Fishing Gear Design and Construction and Marine Protected Areas organized from 30 September to 3 October 2003 by SEAFDEC/TD in Samutprakan Thailand, concluded that all participating countries have in place their respective national legislations, policies and plans including resource enhancement activities to promote conservation and management of marine resources. However, this does not include Singapore because the country has no national policies or agencies managing coral reefs and reef resources.

With regards to resource enhancement activities, most of the participating countries have promoted ARs, stationary fishing gears (SFGs), and MPAs as approaches towards conservation and management of coastal resources.

✓ Cambodia, and Myanmar are currently promoting only MPAs but with the intention to expand to other potential measures

✓ Singapore is basically promoting only re-stocking to increase resident fish stocks and game fishing as well as ARs but not SFGs as these are considered obstacles in navigation pathways

✓ Vietnam is in the initial stage of deploying ARs

Nonetheless, resource enhancement activities in most countries generally focus on the following objectives:

✓ To mitigate impacts and loss of habitats due to natural and man-made destructions

✓ To enhance marine productivity and biodiversity of coastal resources

✓ To provide physical obstruction against invasion of trawlers into coastal areas

✓ To provide productive and alternative near shore fishing areas to small-scale fishermen

✓ To promote sustainable livelihoods such as eco-tourism and small-scale selective fishing in the use of coastal marine resources

KEY ISSUES/CHALLENGES ON ENHANCEMENT OF FISHERIES RESOURCES

❖ **Initial Assessment**

Appropriate measures and assessment for any enhancement program should be formulated together with the investments for these projects, *e.g.* ARs includes funds, time, labor, logistics support. So, the feasibility of each program should be assessed.

❖ **Perspective in Fisheries *Refugia* Management**

Development of the fisheries *refugi*a concept as a tool for integrating fish stock and habitat management had been undertaken by the UNEP/GEF Regional Working Group on Fisheries in the South China Sea (SCS) area in close collaboration with SEAFDEC, FAO, IUCN, and World Fish Center during the period 2003-2008.

The concept of *refugia* was later on elaborated and refined, and priority *refugia* sites were identified, based on the outputs of regional and national level experts and fishing community consultations; national reports on fisheries, mangroves, coral reefs, sea grass, and wetlands from the seven participating countries of the SCS Project.

Moreover, 135 habitat site characterizations had been prepared during the SCS Project; the SCS meta-database and GIS were developed; and compiled information had contributed directly by fisheries and habitat focal points. This has been supported by three regional training courses and 12 national training seminars on the scientific and management aspects of operating regional *refugia* system. Cost effectiveness was a key criterion for the development of the *refugia* initiative, which was aimed at improving the use of area-based approaches to fish stock and habitat management, while overcoming the problems associated with emphasis on no-take Marine Protected Areas in the region. The latter includes low fishing community acceptance, and high costs in terms of displacement of fishers and enforcement. The fisheries *refugia* initiative addresses the present problems by drawing on fisheries management concepts that are easily understood at the fishing community level and emphasizes on the sustainable use of fisheries resources and their habitats rather than prohibiting fishing activities. In the promotion of Fisheries *Refugia*, the ASEAN and SEAFDEC adopted the "UNEP/GEF Regional Guidelines on the Use of Fisheries *Refugia* for Sustainable Capture Fisheries Management in Southeast Asia" in April 2006. The Guidelines is part of the ASEAN-SEAFDEC Regional Guidelines for Responsible Fisheries in Southeast Asia that were developed to regionalize the FAO Code of Conduct for Responsible Fisheries for adoption in the Southeast Asian region.

❖ Regional Collaboration on Trans-Boundary Fish Stocks

In the regional waters, migratory fish pass through overlapping 'exclusive economic zones' (EEZs) is often claimed by more than one country. As fish may be dependent on habitats in the competitive areas or on either side of the EEZs, there is a need to develop viable fisheries management systems, which in the end could ensure the enhancement of aquatic resources and the sustainable use of the resources.

❖ Issues for Future Consideration

- ✓ Common understanding on the purpose of resource enhancement tools particularly fisheries *refugia*
- ✓ Types of resource enhancement measures and activities and their context/implications for conservation and management purposes (ARs vs. FADs, fisheries *refugia*, MPAs vs. marine parks and sanctuaries, etc.)
- ✓ Directions and needs for supporting research, legislations and tools on ARs for resource enhancement
  a. Durability and appropriate designs and installation of AR modules
  b. Studies on appropriateness and effectiveness of different AR modules
  c. SFGs as resource enhancement tool for conservation and management purposes for coastal resources
- ✓ Regional source of information including the system to facilitate information and experience sharing including guidelines for resource enhancement promotion
- ✓ Balancing objectives and benefits of environmental, economic and social aspects of the conservation and management policies and plans for coastal development
- ✓ Guidelines on criteria, conduct of indicators and impact assessment of resource enhancement activities
- ✓ Integrating resource enhancement into innovative management plans, strategies and approaches for sustainable utilization of coastal areas
  a. Management framework
  b. Resource use pattern in the resource enhancement areas
  c. Involvement of communities and fishers
- ✓ Resource enhancement is not the only solution – needs for other measures (*i.e.* stock enhancement, management measures, etc.) to supplement conservation and management of coastal resources

REFERENCES

Baird, I. G., 2006. Strength in diversity: fish sanctuaries and deep-water pools in Lao PDR. Fisheries Management and Ecology; 13: 1–8

Bodiguel, C.; Gréboval, D.; Maguire, J.J. (eds.), 2009. Factors of Unsustainability and Overexploitation in Marine Fisheries – Views from the Southern Mediterranean, West Africa, Southeast Asia and the Caribbean. FAO Fisheries and Aquaculture Circular. No. 1037. Rome, FAO; 89 p

Department of Fisheries, 2008. The Master Plan Marine Fisheries Management of Thailand; 53 p

FAO, 2009. FAO FishStat Plus database. Capture Fishery Production 1950-2007. Rome, FAO

SEAFDEC, 2004. Proceeding of the 1st Regional Workshop on Enhancing Coastal Resources: Artificial Reefs, Stationary Fishing Gear Design and Construction and Marine Protected Areas, 30 September- 3 October 2003. Southeast Asian Fisheries Development Center. TD/SP/32

SEAFDEC, 2005. Proceeding of the 2nd Regional Workshop on Enhancing Coastal Resources: Artificial Reefs in Southeast Asia, 9-12 November 2004. Southeast Asian Fisheries Development Center. TD/SP/33

Stobutzki, I.C., Silvestre, G.T., Abu Talib, A., Krongprom, A., Supongpan, M., Khemakorn, P., Armada, N., Garces, L.R., 2006. Decline of demersal coastal fisheries resources in three developing Asian countries. Fisheries Research 78: 130–142

Supongpan, S., 2006. Artificial reefs in Thailand. Southeast Asian Fisheries Development Center, Training Department. TD/TRB/74; 23 p

UP-MSI, ABC, ARCBC, DENR, ASEAN, 2002. Marine Protected Areas in Southeast Asia. ASEAN Regional Centre for Biodiversity Conservation, Department of Environment and Natural Resources, Los Baños, Philippines; 142 p

Yasook, N, 2008. Assessing the Abundance of Demersal Fishery Resources in Southeast Asian Waters. pages 20-22. In Fish for the People: Vol. 6 No. 2. Southeast Asian Fisheries Development Center. Bangkok; 48 p