FISH for the PEOPLE

A Special Publication for the Promotion of Sustainable Fisheries for Food Security in the ASEAN Region

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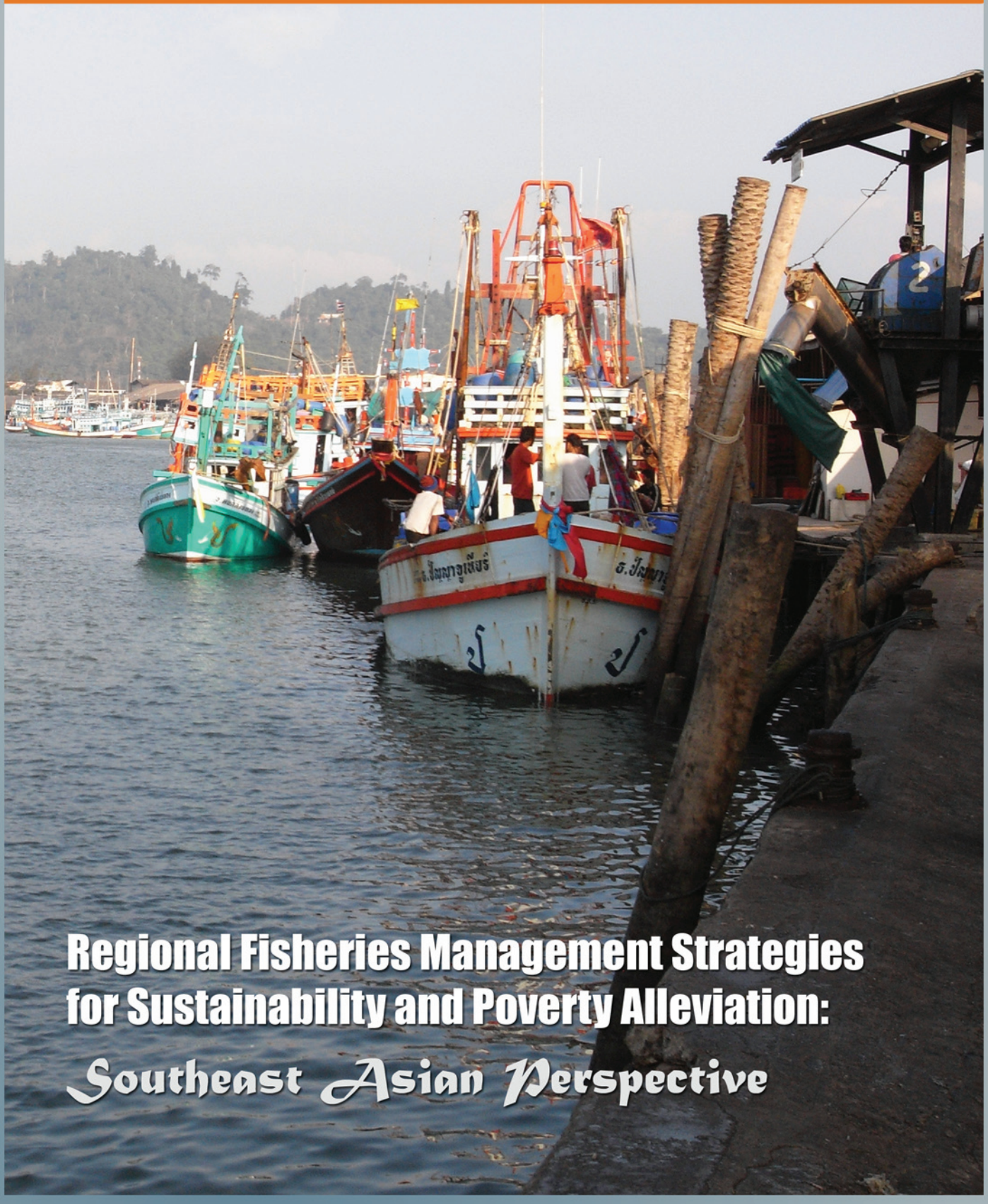

Regional Fisheries Management Strategies for Sustainability and Poverty Alleviation:

Southeast Asian Perspective

Southeast Asian Fisheries Development Center

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Editorial

In the Southeast Asian region, the development of regional fisheries management systems could be a way out for rural fisheries communities from persistent poverty. Such systems should be workable for the tropical multi-species nature, the large number of people involved fisheries in the Southeast Asian countries, and the wide range of fisheries activities from marine capture to inland capture fisheries as well as aquaculture. The said management system should not only focus on the sustainable use of fisheries resources but also on the economic improvement of the fishers' livelihood.

In the development of the Management Systems, the regional specificities and requirements should be taken into account while mobilizing "local knowledge". In SEAFDEC, the Regional Advisory Committee on Fisheries Management in Southeast Asia (RAC) has been recently established and one of the concerns of RAC is the promotion of an innovative fisheries management in the region to address poverty alleviation in the fisheries communities. In addition, the ASEAN Regional Fisheries Management Mechanism (ARFMM) was also established as a broad mechanism that would cover both marine and inland fisheries, focusing on the management of specific habitats and fish species at the sub-regional level. In addition, the ARFMM emphasizes on the promotion of Monitoring, Control and Surveillance (MCS), supporting the implementation of port State and flag State measures as well as conduct of consultations on zoning of special "management" areas through the establishment of refugias, protected areas, etc.

In marine capture fisheries, the need to institute management mechanism at the regional level becomes very apparent considering the various factors that impact its sustainability, such as the migratory nature of the fish stocks, the fishing licenses provided to foreign vessels, and the mobility of fishing crews. Increasing attention is now being given in addressing illegal, unreported and unregulated (IUU) fishing not only by foreign vessels but by domestic vessels as well.

Aquaculture is also confronted with many constraints which should be addressed as these impede its sustainable development. The increasing costs of inputs and other operating costs such as feeds make it difficult for the fish

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farmers to sustain their operations making aquaculture operation more risky. Stocking density in ponds could not be increased beyond limits as this could lead to incidence of diseases outbreaks. The recent requirements for aquaculture products to be eco-labeled add more costs to aquaculture operations. Best management practices in aquaculture therefore call for the need to mitigate not only environmental impacts but social concerns as well.

Inland capture fisheries exploit the wild freshwater aquatic species in natural lakes, rivers, swamps and wetlands, and reservoirs that constitute important fishing grounds. However, information on the actual production from inland capture fisheries is rather very scarce making it difficult to undertake assessment study of the inland fishery resources in the region. It is therefore necessary to establish a data collection and analysis mechanism in order to evaluate extent of exploitation of the inland fisheries resources in the Southeast Asian region.

SEAFDEC therefore is pushing for development of management systems following an ecosystem-based approach for the sustainability of fisheries in the Southeast Asian region. Such comprehensive management system should cover the wide range of fisheries that contribute to the region's increasing fish production and thus, address the sustainability of capture fisheries, aquaculture and inland fisheries in Southeast Asia.

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FISH for the PEOPLE is a special publication produced by the Southeast Asian Fisheries Development Center (SEAFDEC) to promote sustainable fisheries for food security in the ASEAN region.

Towards Sustainable Fisheries and Aquaculture in Southeast Asia: A Call for the Development of Regional Fisheries Management Strategies

Siri Ekmaharaj, Magnus Torell and Somboon Siriraksophon

Fish is by many, the preferred source of food as it is low in cholesterol and with high nutritional value. The Southeast Asian countries (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam) are major producers of fish contributing about 15% (about 24 million metric tons) to the world's total fisheries production in 2006 (capture and aquaculture combined) which was about 160 million mt (**Table 1**). While the region's capture fisheries over the past two decades showed a 5-year average increase of 11%, aquaculture performed much better with a 5-year average increase of 34%. On the other hand, inland capture fisheries showed a 5-year average increase of 14% from 1981 to 2006.

Trends of Marine Capture Fisheries, Aquaculture and Inland Capture Fisheries of Southeast Asia

Trends referred to with regards to marine capture fisheries in the Southeast Asian region in the context of this document, are in principle based on landings of aquatic products

Table 1. Fish production trend of Southeast Asia (SEA) and China by five-year averages (mt)

	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006
SEA Total	**8,568,544**	**10,557,224**	**13,198,772**	**15,543,652**	**20,042,475**	**23,948,854**
Inland Capture	982,141	983,393	1,048,013	1,172,835	1,548,503	1,889,803
Marine Capture	6,542,085	8,065,140	9,793,830	11,212,775	12,904,211	13,762,586
Aquaculture	1,044,318	1,508,691	2,356,929	3,158,042	5,590,761	8,296,465
China Total	**7,129,908**	**12,559,052**	**24,148,501**	**43,617,421**	**55,881,144**	**62,712,523**
Inland Capture	441,756	731,163	1,222,910	2,089,733	2,367,668	2,549,199
Marine Capture	3,252,190	5,062,912	8,593,286	14,367,860	14,698,594	14,866,757
Aquaculture	3,435,962	6,764,977	14,332,305	27,159,828	38,814,882	45,296,567
World's Total	**83,604,545**	**102,089,234**	**113,731,499**	**133,739,382**	**150,187,506**	**159,897,138**
Inland Capture	5,502,299	6,160,741	6,610,436	8,108,997	9,028,666	10,069,279
Marine Capture	68,769,172	80,837,610	82,542,454	86,153,783	85,374,730	83,081,146
Aquaculture	9,333,074	15,090,883	24,578,609	39,476,602	55,784,110	66,746,713

Source: *FAO FishStat Plus 2008*

that are caught within the region (EEZ's, archipelagic waters, etc.) and not outside of national jurisdictions. To manage the fisheries in the region it is necessary to take into account various factors that include the migratory nature of the fish stocks, the fishing licenses provided to foreign vessels, unregulated nature of domestic fisheries, the whole perspective of small-scale fisheries, and the high regional mobility of fishing crew. Considering such factors that could impede the sustainable development of fisheries in the region, there is an imperative need to address the management of fisheries both at national and regional level.

Moreover, illegal, unreported and unregulated (IUU) fishing has been receiving increased attention in the region as well as in the international arena, as reflected in ASEAN Heads of States urging for increased efforts to combat illegal fishing as well as eight of the ASEAN Member Countries signing up on the Regional Plan of Action (RPOA) to combat IUU fishing. For the long-term sustainability of fisheries, Southeast Asian countries could also consider operating in neighboring waters while at the same time improve the regulations and management of their respective domestic fisheries.

Box 1. Identified sub-regional fishing areas in the Southeast Asian region

1. Lower Mekong River Basin (LMRB), a very important freshwater and floodplain fisheries area shared by Cambodia, Lao PDR, Thailand, and Vietnam (CLTV)
2. Gulf of Thailand which features a large amount of small-scale and coastal fishing operations and large-scale fishing as well as reported IUU fishing and unreported landings across boundaries, shared by Cambodia, Malaysia, Thailand, and Vietnam (CMTV)
3. Eastern and Southern South China Sea and Sulu Sulawesi Sea area characterized also by a large amount of small-scale and coastal fishing, small-scale vessels, large-scale fishing, and IUU fishing, bordered by Brunei Darussalam, Indonesia, Malaysia, Philippines and Vietnam (BIMPV)
4. Timor-Arafura Sea which features small-scale traditional fishing, industrial fishing for larger pelagic fish including licensed fishing by foreign vessels and IUU fishing, bordered by Australia, Indonesia, Papua New Guinea and Timor Leste (AIPT)

   Note: Australia, Timor Leste and Papua New Guinea are not members of the ASEAN
5. Andaman Sea (and Malacca Straits) which shows the same pattern of small-scale, large-scale fisheries and IUU fishing, shared by India, Indonesia, Malaysia, Myanmar, and Thailand (IIMMT)

   Note: India is not a member of the ASEAN
6. Northern South China Sea and the Gulf of Tonkin with similar characteristics as that of the Gulf of Thailand, is shared by China, the Philippines and Vietnam (CPV)

   Note: China is not a member of the ASEAN

Therefore, the establishment of appropriate regional and sub-regional fisheries management mechanisms for Southeast Asia has been progressively pushed forward. Specifically, the establishment of the ASEAN Regional Fisheries Management Mechanism (ARFMM) covering both marine and inland fisheries was envisaged to address fisheries management issues. Although ARFMM is a broad and more general mechanism, it will not address stocks or species in particular but more on specific habitats and fish species at the sub-regional level.

The region's sub-regional areas (**Box 1**) have specific profiles and challenges to address, but the common elements to be worked out for each sub-regional area management mechanism, could include information exchange on fisheries activities (officially recognized fishing and IUU fishing), shared and migratory stocks, results from port monitoring activities (landings by foreign vessels), social mobility of fisheries-related workforce, and laws and institutional arrangements. Other aspects for cooperation at the sub-regional level could include networking on Monitoring, Control and Surveillance (MCS), mutual support in the implementation of port State and flag State measures as well as consultations and agreements on the design and zoning of special "management" areas such as refugias, protected areas, etc. While this could be outside the mandate of national fisheries agencies, the settlement and definitions of corresponding maritime boundaries should also be pushed ahead.

Aquaculture, which is mostly done as national operation and well within national policy frameworks, is also confronted with many constraints that impede its sustainable development (Ekmaharaj, 2009). The very fluctuating oil prices led to increased costs of inputs and other operating costs such as feeds and transportation, making it difficult for the fish farmers to continue their operations. Although aquaculture production has increased, farm gate prices of aquaculture products continue to decrease. This situation results in less profits for the fish farmers and the whole aquaculture operation is becoming more risky. Although increased stocking density in ponds could be an option, it could also lead to more frequent water pollution followed by diseases outbreaks.

On top of this, the farmers still have to face the impacts of other natural disasters such as floods and storms. Furthermore, recent demands by consumers to trace the products (traceability) throughout the production chain, has led to the need for aquaculture products to be labeled, i.e. eco-labeling (Ekmaharaj, 2006). This in turn adds more costs for farmers although meeting such international requirements would also provide them with increased market

opportunities. Moreover, in order to mitigate environmental impacts and address social concerns, some improvements on farm routine practices are needed but this could potentially mean additional investment costs.

Inland capture fisheries on the other hand, exploit mostly the wild freshwater aquatic species including migratory species that move from the oceans to freshwater bodies. The region abounds in natural lakes, rivers, swamps and wetlands, and reservoirs that constitute important fishing grounds. However, little information is available on the real-time production from inland capture fisheries even considering that this sector has been providing the rural populace in many countries with sufficient source of animal protein, job opportunities and livelihoods as well as income. Lack of information remains a main drawback, making the assessment of inland fish stocks very difficult to undertake.

With such situation, it is impossible to evaluate whether the inland fisheries resources of the region have been over-exploited or under-exploited based only on the reported decreasing or increasing production. Moreover, the detailed analysis of the catch trends with regards to species composition could not also be established. The case of Cambodia's inland capture fisheries production for example, is something that should be reckoned with. While in the early 80s, its production from inland waters was reported to be only a little over 50,000 mt, production in 2006 has increased by more than 800% (**Table 2**). More than 80% of Cambodia's freshwater fishes are produced from the Tonle Sap Great Lake, a natural flood reservoir of the Mekong River which during the flood season the lake water area could rise to 10,000-12,000 km^2 with a water depth of about 10-14 m, while in the dry season the water area is about 2,000-3,000 km^2 with an average depth of less than 1.0 m. During the monsoon, the water area expands to the inundated forest creating an enormous area of about 6,000 km^2, very ideal for fish breeding, spawning, nursery and feeding grounds.

The Mekong River region in Cambodia is one of the richest natural resources in the world in terms of ecological diversity. The high productivity is a result of the annual inundation by the Mekong River of the large floodplains around the Tonle Sap Great Lake in central Cambodia and the Mekong floodplains near its capital city Phnom Penh. It is in these areas that important fish habitats such as flood forests are located. Like in Cambodia, the region's inland fisheries should also be evaluated in terms of potentials considering the vast freshwater resources that include rivers, streams, lakes, reservoirs, ponds, channels, low-lying paddy-fields, etc., which are favorable for fishing (**Table 3**). However, the freshwater resources in the region could be overfished due to lack of protection and appropriate management measures.

The data in **Table 3** seemed to indicate a different rate of production from the country's inland fisheries. This is something that should also be reconciled through improved collection of statistics using pre-established indicators. Considering that lake and reservoir fisheries are also commonly operated in the region, and are important for the socio-economic wellbeing of the peoples in the rural communities. Such resources should be properly managed in order to avoid over-exploitation.

It should also be considered that most of the man-made reservoirs or dams are constructed for development purposes such as irrigation and hydropower supply with fisheries

Table 2. Southeast Asian production from inland capture fisheries by five-year averages (mt)

	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006
Brunei Darussalam	105	123	33	23	12	10
Cambodia	57,010	60,632	69,800	137,762	325,610	422,000
Indonesia	267,094	283,898	312,516	314,918	310,426	301,140
Lao PDR	22,702	20,400	21,682	24,158	30,768	29,800
Malaysia	4,665	1,654	2,241	3,835	3,885	4,165
Myanmar	141,230	139,598	143,368	160,206	348,206	631,120
Philippines	280,752	240,130	212,804	156,140	136,424	160,498
Singapore	431	141	21	-	-	-
Thailand	103,362	108,740	166,330	203,707	200,319	197,270
Vietnam	104,790	128,077	119,218	172,086	192,853	143,800
SEA Total	**982,141**	**983,393**	**1,048,013**	**1,172,835**	**1,548,503**	**1,889,803**
World's Total	**5,502,299**	**6,160,741**	**6,610,436**	**8,108,997**	**9,028,666**	**10,069,279**

Source: *FAO FishStat Plus 2008*

Table 3. Inland freshwater resources of selected countries in the Southeast Asian Region

Country	Total freshwater resources (ha)	Production in 2006 (mt)	Major Species Harvested
Cambodia (Great Lake Tonle Sap)	200,000-300,000 ha (dry); 1,000,000-1,200,000 ha (flood season)	422,000 (ave: 1,700 kg/ha (dry) or (ave: 400 kg/ha (flood)	Major species caught are cyprinids (49%) and snakeheads and others (51%), the most common species harvested are: mud carp, climbing perch, snakehead, moonlight gourami, mystus catfish, small shrimps, etc.
Indonesia (Java, Sumatra, Kalimantan, Sulawesi, Irian Jaya, Bali)	55,000,000	301,140 (ave: 6 kg/ha)	Snakeheads, catfishes, featherback, freshwater prawns, clams, climbing perch, carps and other cyprinids, eel, gourami, silver barb, tilapia, etc.
Malaysia (Peninsular, East)	100,000	4,165 (ave: 42 kg/ha)	Carps, catfish, tilapia, freshwater prawns, etc. Aquarium fishes are also caught (recorded in pieces).
Myanmar (Rivers, ponds, reservoirs)	8,200,000	631,120 (ave: 77 kg/ha)	Carps, rohu, hilsa, catfish and other freshwater fishes, freshwater prawns
Philippines (north and south)	496,100	160,498 (ave: 325 kg/ha)	Water snails (37%), tilapia (23%), carps (7%), mudfish (6%), lizard fish (4%), theraponids (3%), prawns (3%), gourami (3%), catfish (4%), climbing perch (1%), others (10%).
Thailand (Lakes, swamps, dams, village ponds)	1,285,400	197,270 (ave: 155 kg/ha)	Climbing perch, carps, pangas and other catfishes, silver barb, gourami, snakeheads, tilapia, etc.
Vietnam	32,956,000	143,800 (ave: 5 kg/ha)	Freshwater fishes, Siamese crocodile, natantian decapods, aquatic invertebrates

considered only partly for economic purposes. Efforts should therefore be exerted to optimize the exploitation of the fisheries resources in such freshwater bodies. Napaporn and Ekmaharaj (2008) cited that in the case of Thailand, after the application co-management and rights-based concepts in reservoir fisheries management, many rural fisheries communities have been able to earn sufficient incomes from reservoir and lake fisheries.

Changes in Fisheries and Aquaculture Production from Southeast Asia

There are major and evident changes in the fisheries and aquaculture sectors of Southeast Asia, in terms of production and consumption. Comparing the changes in fish production of the Southeast Asian countries with the world's total and that of China, the Southeast Asian countries contributed in 1986-1990 an average of 10% while China contributed an average of 12% to the world's fisheries production. This trend was changed in 1996-2000 when the Southeast Asian countries contributed 12% while China's contribution was up by 33%.

Similarly in 2006, about 15% was contributed from the region to the world's fish supply while 39% was contributed by China (**Table 1** and **Fig.1**). In a similar way, the production pattern of the other countries varied, while in 1986-1990 the average contribution from the other countries was 78%, this decreased to 55% in 1996-2000 and further to 46% in 2006. This trend has led to the present situation where the Southeast Asian countries and China now contribute 54% to the world's total production.

Looking at the contribution of the Southeast Asian region to the total fish supply since the early 80s, the trend shows that the contribution from capture fisheries has been almost static while that from aquaculture has been steadily increasing (**Fig. 2**).

Fig. 1. Contribution of SEA and China to World's Total Fish Production

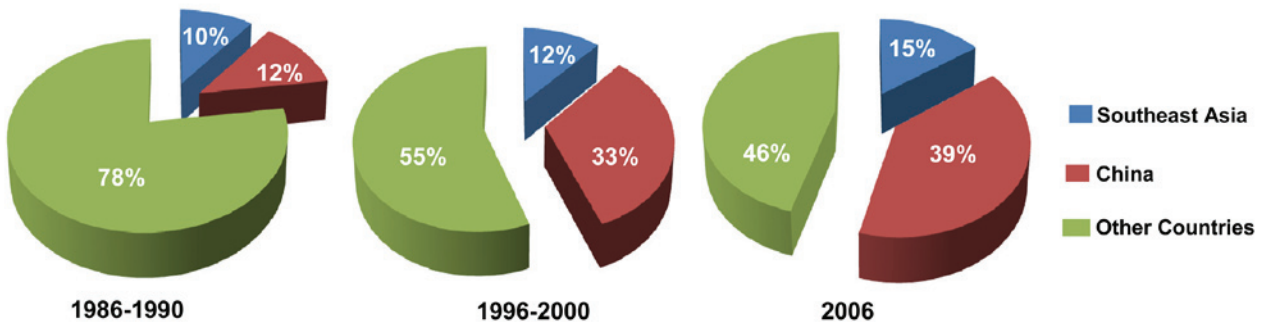
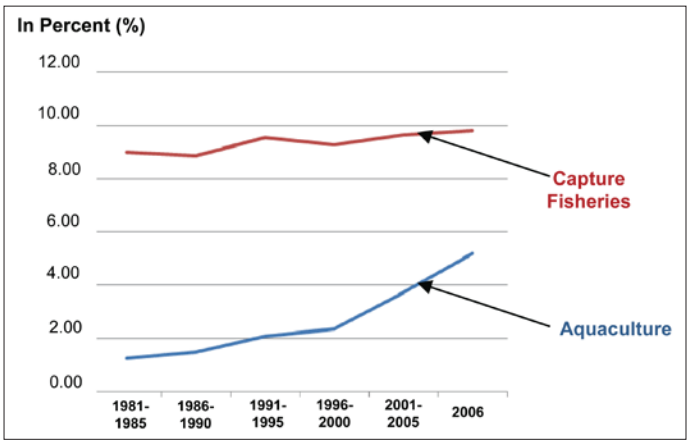


Fig. 2. Per cent contribution of Southeast Asia's capture fisheries (marine and inland) and aquaculture to the world's total fish supply



In 2006, the relative fisheries production for Southeast Asia showed 8% for inland capture fisheries, 57% for marine capture fisheries and 35% aquaculture (**Table 4**). The total production was about 24 million metric tons with the main part coming from marine capture fisheries and aquaculture. Southeast Asia provides almost 15% to the total fish production in the world. Indonesia has the highest production in Southeast Asia contributing about 29% followed by Philippines, Thailand and Vietnam providing 18%, 17%, and 15% to the total fish production of Southeast Asia, respectively.

On the other hand, the average apparent per capita fish consumption in Southeast Asia in 1997 was 22.9 kg and considering its total population of 491.3 million (SEAFDEC, 2001), the fish requirement of the region in 1997 was about 11 million mt or about 72% of the region's fish production (15 million mt) was consumed. In 2006, the average per capita fish consumption in Southeast Asia increased to 26.8 kg (NOAA, 2003). With the region's estimated total population of 564.2 million in 2006 (Population Reference Bureau, 2006), the total fish consumed was 15,120,560 mt or about 63% of the region's total fish production of 23,948,854 mt. Comparing with China, its relative per capita fish consumption in 2006 was about 25.4 kg (NOAA, 2003) and with an estimated total population of 1,321.9 million during the same period its fish requirement for the same year was about 33,576,260 mt or 54% of its total fish production in 2006 (62,712,523 mt).

Sub-regional Fishing Areas in Southeast Asia

Considering the vast water resource of the Southeast Asian region, the areas suitable for sub-regional management arrangements, can be divided into six sub-regions that cover two or more countries including one for inland fisheries (**Fig. 3**).

At present, initial discussions to set sub-regional area planning has been done for Sub-regional Areas 1, 2, 3 and 4. The Sub-regional Area 1 (LMRB) has a strong and active cooperation in terms of technical and policy aspects under the Mekong River Commission (MRC). With respect to Sub-regional Area 5 some dialogues have been conducted as a result from the post-tsunami activities while for Sub-regional Area 6, recent development has taken place through bilateral talks between China and Vietnam. The main features of the six sub-regional areas are shown in **Box 2**. Indications are apparent for Sub-regional Area 4 to be sub-divided in order that it covers Northern Borneo and Sulu Sulawesi, only.

Table 4. Total fish production of the Southeast Asian countries by five-year averages (mt)

	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006
Brunei Darussalam	3,034	2,947	2,893	4,345	2,508	3,100
Cambodia	64,694	87,277	110,763	184,773	406,024	532,700
Indonesia	2,197,566	2,917,612	3,898,826	4,823,700	5,948,006	6,989,033
Lao PDR	25,200	27,600	32,950	50,315	94,271	107,800
Malaysia	789,188	914,008	1,134,854	1,340,900	1,465,790	1,498,732
Myanmar	605,799	710,903	783,721	930,636	1,716,781	2,581,780
Philippines	1,991,068	2,290,023	2,677,314	2,869,181	3,648,507	4,414,310
Singapore	21,495	15,925	12,739	11,858	7,621	11,676
Thailand	2,149,494	2,694,825	3,343,835	3,583,823	3,915,486	4,162,096
Vietnam	721,006	896,104	1,200,876	1,744,121	2,838,481	3,647,627
SEA Total	8,568,544	10,557,224	13,198,772	15,543,652	20,042,475	23,948,854
Inland Capture	982,141	983,393	1,048,013	1,172,835	1,548,503	1,889,803
Marine Capture	6,542,085	8,065,140	9,793,830	11,212,775	12,904,211	13,762,586
Aquaculture	1,044,318	1,508,691	2,356,929	3,158,042	5,590,761	8,296,465

Source: *FAO FishStat Plus 2008*

Box 2. Main features of the six sub-regional areas in Southeast Asia

(1) Lower Mekong River Basin (LMRB)

The Mekong River is one of the world's most productive freshwater bodies with an estimated production of 2.5-3.0 million mt each year. The area is mainly floodplain where riverine fisheries with a great variety of fishing gear are practiced and with a very high involvement of rural people and farmers in fishing (part-time or full-time). Critical for the reproduction of fish is the seasonal changes in the monsoon and the importance of annual floods. The threat to the resource is more from infrastructure rather than the fisheries itself as this could affect the flooding patterns. The increasing fisher population (more people involved in fishing) and infrastructure development (dams and reservoirs construction) is one of the major threats to the sustainability of Mekong fisheries. In addition, there are conflicts within the fishery itself in terms of different land and water uses. Opportunity lies in securing the seasonal flooding, fish migration paths and dry season management of freshwater fish broodstock. Fish products from the LMRB are very important for local consumption and for a substantial regional export. Although export data is not readily available, the potentials for increased export in the region and elsewhere are good. The Mekong River is one of the world's most important rivers in terms of aquatic biodiversity providing habitat for the world's biggest freshwater fish, the giant catfish (Pangasianodon gigas) which is on the IUCN and CITES lists for being highly endangered. MRC was established "for the sustainable development of the Mekong River Basin" with Cambodia, Lao PDR, Thailand and Vietnam as signatories, the same countries that border the LMRB. The MRC Agreement also calls for fisheries management for the region. There are now fisheries management arrangements based on additional agreements, such as fishing quota for the giant catfish in the LMRB. Although China and Myanmar are the only riparian states that have not signed the MRC Agreement, these countries have observer functions at official MRC meetings.

(2) Gulf of Thailand

The Gulf of Thailand used to have one of the highest resource potentials in the Southeast Asian region due to its shallow topographic bottom features that forms the Gulf into a large basin less than 85 meters deep. Many important rivers bring down nutrients into the Gulf, especially in the upper Gulf. Fisheries in the Gulf are diverse with small-scale coastal and large-scale fishing operations in the offshore areas. The major fisheries focus on shellfish, various demersal species, small pelagic species such as Indo-pacific mackerel, round scads, etc. (Ekmaharaj, 2007). At present, due to the absence of fisheries management and the practice of open access fisheries, the resources especially the demersal resources are depleted. All types of fishing in the Gulf have caused high pressure on the resources. The catch per unit effort (CPUEs) showed that 20 years ago the catch was 300 kg/hrs while presently it remains only at 20 kg/hour (DOF, 2007). In addition, due to the depletion of resources, many problems arise such as conflicts between groups of fishermen, IUU fishing and trans-boundary fishing. This in turn reduces the opportunities for domestic and export markets and impacts the livelihoods of the fishermen.

(3) Timor-Arafura Sea

In addition to its coastal resources, the Timor-Arafura Sea is also a significant source of large pelagic species. Fisheries in this area have two distinct features, namely: coastal traditional fisheries; and commercial fisheries using large vessels (including license foreign vessels) fishing large tunas, etc. Some fisheries are under high pressure while other resources are still believed to be abundant. Like in the Gulf of Thailand, there are also conflicts among the groups of fishermen, IUU fisheries and trans-boundary fishing. To strengthen the position of the traditional fishermen, there is a need to secure the traditional fishing rights in the coastal areas. There still exist good opportunities for export of large pelagic fish species if the resource is well managed and controlled.

(4) Southern and South Eastern South China Sea and Sulu-Sulawesi Sea

This sub-regional area can be separated into three parts: (1) South and southeastern part of the South China Sea (SCS), (2) Sulu Sea, and (3) Sulawesi Sea covering Banda Sea, Molucca Sea, Flores Sea and Celebes Sea. This sub-regional area has a great biodiversity in terms of coastal and offshore resources. It is noted for many important habitats existing in the area, such as marine turtle habitats, tuna breeding and spawning grounds (Tim L. O. Davis., 2008). The topography of bottom indicates that almost 80% of the sea areas are deep, with depths ranging from 200 to 5,000 m. Its coastal areas are not suitable for trawling therefore demersal resources are underexploited. In addition, many fishing gear such as purse seine and ring-net are being used in the area targeting small pelagic fishes, namely: neritic tuna, round scads and mackerel. Opportunities in the sub-region for future fisheries development include the challenge to further explore the potentials of deep sea fisheries where oceanic squid is also one of the potential resources. The major problems of the sub-region include: (1) IUU fishing by foreign vessel and neighboring IUU fishing vessels and frequent illegal fishing targeting sea turtles, especially around the Turtle Islands in Sulu Sea; (2) small pelagic fisheries by purse seine with Fish Aggregating devices (FADs) also catch the juveniles of yellow fin and big-eye tunas, affecting the tuna stock and thus, responsible fishing technology and practices need to be enforced (Siriraksophon, 2008); and (3) important pelagic fish species are straddling and highly migratory species which implies a need for joint approaches to management.

(5) Andaman Sea

The Andaman Sea faces and connects the Indian Ocean, but is almost semi-enclosed due to the Andaman and Nicobar Islands that are "fringing" the Andaman Sea in the eastern part. The geographic and bottom features are quite distinct compared to the Gulf of Thailand. The area includes a large continental shelf in the northern part of Myanmar and a deep basin down to 2,000 m in the central part of the Andaman Sea. Many rip-currents occur where two water masses meet producing an abundance of small pelagic fishes in the offshore waters. This area has great biodiversity on its continental shelf and continental slopes as well as further offshore. Many commercial fish species thrive on the continental slopes where the depth varies between 150-300 m, and there is an abundance of fish species in the Ayeyarwaddy delta. Even further offshore and into the deeper waters, especially in the northern part near Myanmar waters, large pelagic species are also abundant such as the yellow fin and bigeye tunas, sword fish, marlin, sailfish and thresher sharks (Promchinda S. and Siriraksophon S., 2007). Seasonal changes such as the northwest and southeast monsoons are beneficial and could be taken advantaged of in order to reduce the rate of over-exploitation and to build up conservation measures to allow the fish stocks to recover. Fishing activities practically stop during the southeast monsoon and closed seasons could be introduced. Considering the tuna resources in the Andaman Sea, opportunities could include exploring new tuna fishing grounds including the potentials in the Thai EEZ, and the development of deep sea fisheries on the continental slopes from 200-800 m. However, the potentials are limited and recovery rates of deep sea resources are not fully known. Therefore, there is a general need to closely monitor new developments to ensure long term sustainable use of the area's resources.

(6) Northern South China Sea and the Gulf of Tonkin

The area is presently not considered a sub-regional focal area for the RPOA-IUU or other regional initiatives for Southeast Asia. For the Gulf of Tonkin part, dialogue and agreements are discussed between Vietnam and China. In terms of fisheries resources, type of fishery and social dimensions, the area would present similar features as the Gulf of Thailand. Subsequently, pressure on the resources and problems, conflicts and opportunities would show some similarities although different countries are involved.

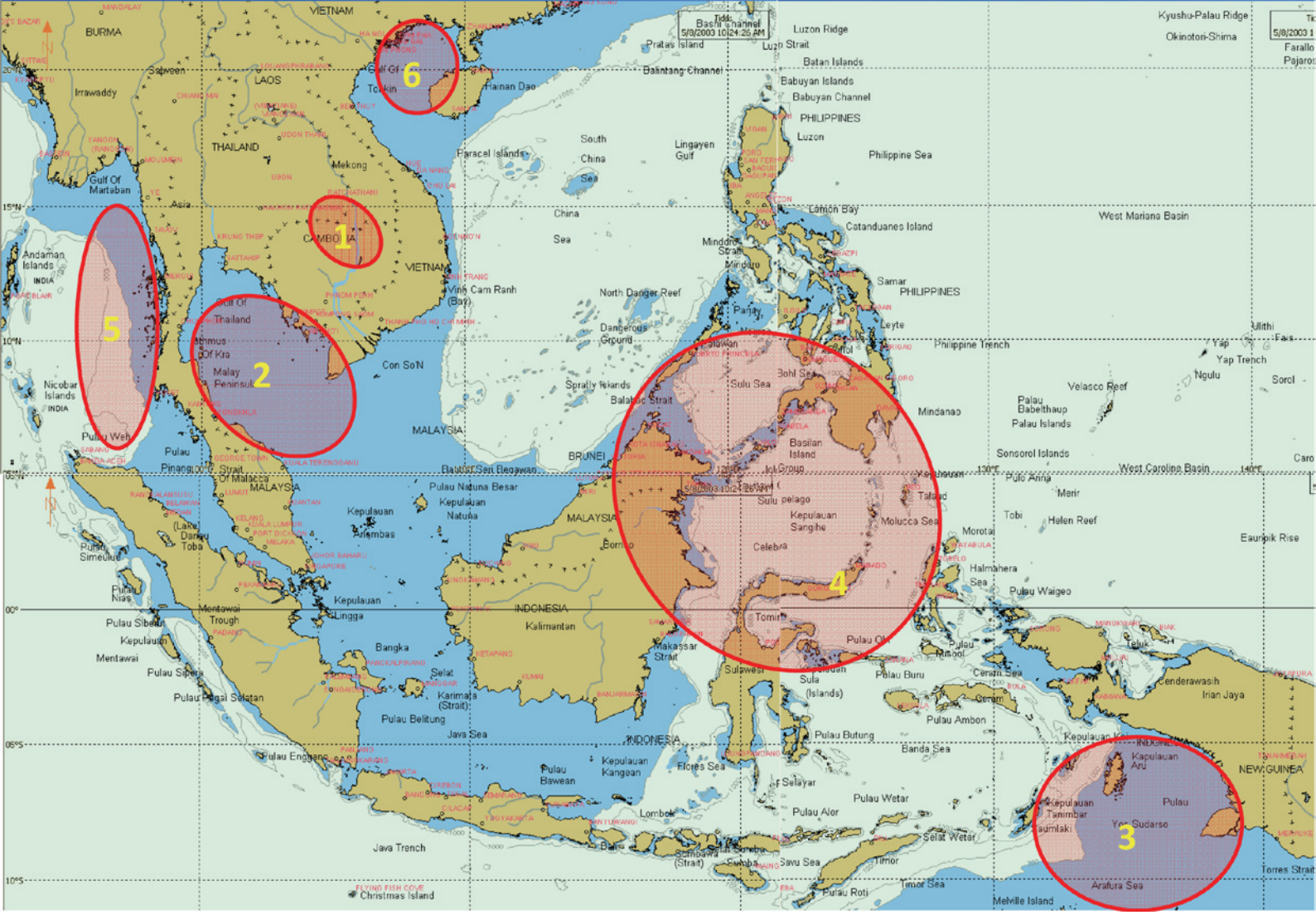


Fig. 3. Sub-regional areas suitable for management arrangements, within the Southeast Asian region

Need for Regional Fisheries Management Strategies in Southeast Asia

Throughout Southeast Asia, signs of decreasing resources are seen and there are frequent reports on over-fishing leading to calls for improved management and reduction in terms of fishing effort. Instances of IUU are widespread which led the countries to get together to formulate a Regional Plan of Action (RPOA) in combating IUU fisheries. The requirements to be able to trace catches, to certify the products (for various reasons) and the increasing demands for labels are things that the fishing industry should cope with. For countries that catch up in addressing such requirements, new avenues for better market opportunities await them. Global, regional and national requirements are becoming more stringent in terms of demands to mitigate impacts on the environment. With the high level of mobility (across borders) of fish workers and the large number of people involved in the fishing sector (fishing and processing) the sector is increasingly being scrutinized in terms of social performance and social well-being and, subsequently, new "demands" can be expected.

While recognizing the dominating role of the Southeast Asian countries in the international seafood trade, it can be envisaged that after establishing sub-regional management mechanisms this would help the ASEAN countries to better manage the fisheries and help maintain and increase their fisheries exports. Good systems of traceability, certification and eco-labeling should also be established. Whatever management measures, the fisheries resources need to be managed and a key element is to limit the fishing capacity while IUU fishing by foreign countries and domestic sources should be prevented. The proposed Regional Fisheries Management Strategies is envisaged to provide a framework for better management and to provide a platform for cooperation within the region or sub-regions, and to comply with the various requirements covered in international instruments and to facilitate the implementation of international standards/procedures and related requirements.

Sub-regional Management and Opportunities for Future Action

Indications have been made that a regional management mechanism or forum covering the whole of the ASEAN (inland and marine areas included), need to be supplemented by arrangements at sub-regional levels to address more area-specific issues, such as habitats, fish species and trans-boundary potential conflicts. A series of consultations to initiate sub-regional arrangements, have been held in three sub-regions since 2008, and for the LMRB under the Mekong River Commission since 1995. Sub-regional

Box 3. Key elements that need be addressed to support the sub-regional fisheries management

- Agreements on information exchange among member countries on various important aspects relevant to fisheries and habitat management (including social aspects)
- Monitoring, Control and Surveillance (M, C and S) are key to common approaches that would be needed to combat IUU fishing
- Support system among members to implement port State measures (FAO Guidelines)
- Implementation of flag State measures
- Development of framework for fishing vessel registration (vessel record and inventory)

working groups are starting to emerge and a Technical Advisory Body (TAB) have been actively working with the MRC Fisheries Programme. The key elements that should be addressed jointly by countries, in support of the sub-regional management are shown in **Box 3**. The demands and requirements from markets around the world are moving towards increasingly detailed information on products with the possibility of tracing the movement of the products from the fishing areas to the "plate".

An ASEAN Fisheries Consultative Forum (AFCF) is also being developed within the institutional framework of the ASEAN. Under the AFCF, sub-regional management arrangements are being considered to better accommodate management needs, habitats functions and type of fisheries in a defined water area, in ways that an ASEAN-wide mechanism alone would not be able to accommodate in a smooth way.

Increasingly, documentations following the production chains should be linked to the process of certification. With this requirement, there is obvious need to upgrade the whole chain of management throughout the various stages of production. With the establishment and development of the sub-regional management arrangements (in support of an ASEAN-wide Forum), countries in the region should cooperate to make fishing operations more sustainable and promote information sharing, improved port monitoring, etc. in order that demands for traceability can be complied with.

Moreover, for the sustainability of aquaculture, Ekmaharaj (2009) suggested various strategies that include: intensifying rural aquaculture, implementing adaptive measures to address the impacts of climate change to aquaculture, adopting mitigating measures for environmental impacts and social welfare, conducting R&D on new aquaculture technologies, and enhancing human resource development (HRD) to enable all stakeholders to develop and improve their skills, knowledge, and abilities. In fisheries and aquaculture, HRD is important so that the stakeholders would become aware and would be able to adopt the various fisheries instruments, commitments and requirements, e.g. the Code of Conduct for Responsible Fisheries, as well as the recently evolving international market-driven requirements, e.g., eco-labeling and traceability.

Rural aquaculture development is a key challenge to open up livelihood opportunities for the rural poor who are oftentimes confronted with many constraints, particularly impediments in terms of technological and management practices due to such factors as lack of access to capital and resources, vulnerability and aversion to risks. Aquaculture operations require access to appropriate skills, land and water, financial

Box 4. Strategies and interventions for sustainability of rural aquaculture

- Adopt low-input technologies with access to credit and infrastructure development as well as other public and private institutional support mechanisms
- Promote integrated agriculture-aquaculture systems considering that the wider adoption of these systems will permit sustainable expansion of aquaculture where it is most needed, improve the productivity and sustainability of farms and reduce impact on the environment (by recycling farm wastes). For example, the adoption of small-scale environmentally friendly mollusks and seaweeds culture by coastal artisanal fishers, as an alternate rural livelihood, has the added benefit of reducing pressure on wild fish stocks and cleaning the coastal waters
- Develop common property water resources such as flood plains, swamps, reservoirs and irrigation structures that can be leased to poor households that otherwise lack productive assets while areas in rural areas that are not suitable for agriculture and which are not critical habitats, can often be used for aquaculture (e.g. saline soils)
- Develop a mechanism that could assess the needs of rural poor and their resources, and promote the adaption of pro-poor technologies considering their local conditions
- Promote pro-poor technologies by addressing a number of concerns such as limited institutional, human and financial capacity, institutional barriers, government restructuring, and lack of government services for development
- Break-down barriers to adoption of aquaculture or improved technologies by the poor such as lack of security of tenure or a well-defined system of land and water use rights, difficulty in accessing inputs, credit and markets, and inappropriate technologies, political influence, and lack of technical assistance
- Institute policies and appropriate institutional arrangements that could channel services to the poor including cooperation among several concerned agencies and enhancing public-private partnerships
- Allow small-scale aquaculture to function largely as a private sector activity in order to sustain its contribution to rural livelihoods
- Ensure that the less advantaged producers such as the rural poor farmers have access to export markets, and fair share of benefits from the production chain
- Promote participatory processes for small-scale producers and organizations of producers into groups and associations in order to extend trade and market links.

capital, organizational arrangements, physical facilities, and infrastructure in order to adopt, operate and sustain relevant aquaculture practices. Bueno (2008) indentified various strategies and interventions for the sustainability of rural aquaculture (**Box 4**) in the Southeast Asian context.

In general, one of the major aspects of sustainability is responsible fisheries management practices. In order to be able to implement such practices, it would require the improved skills and human capacity on the part of all the stakeholders. It has been recently recognized that the success in fisheries management could be attained through the participation of fishing communities and resource users in management through the co-management approach. Here, human resource development would play an important role as the fishing communities as well as the resource users would require new levels of capacity to be able to participate in co-management. This could be attained through intensive training and massive information dissemination.

Better cooperation around management will improve possibilities to certify products, thus provide a better chance for ASEAN countries to develop and maintain the export opportunities for ASEAN fisheries products. Improved traceability and certification provide a good framework to develop various types of labeling schemes, such as eco-labeling. The fisheries resources can be managed by limiting fishing capacity within the sub-region and by integrating fisheries management into habitat management to open up for the wise use of fishery resources. Of growing importance is the need to build upon social responsibility. The sub-regional mechanism would need to address large migration of workforce employed in fisheries, in capture fisheries, aquaculture and in processing plants. Lastly, by working together IUU fishing from foreign countries can also be prevented.

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SEAFDEC Regional Fish Disease Program: Safeguarding the Quality of Aquaculture Products and Environmental Integrity of the Southeast Asian Region

Hiroshi Ogata

In the Southeast Asian region, aquaculture has always been a major part of the economic strategy adopted by many countries for reducing poverty. This is in view of its great potentials to fill the gap between supply and demand for fish and fish products the role that it has maintained as an important producer of high quality protein for domestic consumption as well as a major generator of export earnings. However, the continuing population growth, the decline in marine fish catch, and the widespread poverty in the rural areas of the region make it imperative that sustainable aquaculture be promoted to ensure food security and generate livelihood.

Aquaculture production worldwide has been very promising posting a growth rate of 27% from 2001 to 2006. In 2006, the total production from aquaculture worldwide was 66,746,713 mt of which 8,296,465 mt or about 12% was contributed by the Southeast Asian countries, which showed a production growth of about 51% from 2001 to 2006 (**Table 1**). Compared with production from marine capture fisheries, the region's production for the same period had a growth rate of only about 12%, and in 2006 the region accounted for about 17% of the world's total production from marine capture fisheries (**Table 2**).

Table 1. Production from aquaculture of the Southeast Asian countries (mt)

Countries	2001	2002	2003	2004	2005	2006
Brunei Darussalam	99	157	160	708	708	700
Cambodia	17,500	18,250	26,300	37,515	42,000	50,200
Indonesia	1,076,749	1,137,151	1,228,559	1,468,612	2,124,093	2,219,883
Lao PDR	50,000	59,716	64,900	64,900	78,000	78,000
Malaysia	177,021	183,990	192,160	202,227	205,834	198,317
Myanmar	121,266	190,120	252,010	400,360	485,220	574,990
Philippines	1,220,456	1,338,394	1,448,504	1,717,028	1,895,848	2,092,274
Singapore	4,443	5,027	5,024	5,406	5,917	8,573
Thailand	814,121	954,696	1,064,409	1,259,983	1,304,213	1,385,801
Viet Nam	608,098	728,041	967,502	1,228,617	1,467,300	1,687,727
Total for SEA	**4,089,753**	**4,615,542**	**5,249,528**	**6,385,356**	**7,609,133**	**8,296,465**
World's Total	**48,583,171**	**51,968,834**	**55,202,344**	**59,867,278**	**63,298,924**	**66,746,713**

Source: FAO Fishstat Plus (2008)

Table 2. Production from marine capture fisheries of the Southeast Asian countries (mt)

Countries	2001	2002	2003	2004	2005	2006
Brunei Darussalam	1,578	2,044	2,221	2,417	2,390	2,390
Cambodia	43,200	45,882	55,607	55,817	60,000	60,500
Indonesia	3,967,145	4,074,066	4,383,158	4,321,805	4,406,559	4,468,010
Malaysia	1,235,367	1,276,185	1,287,336	1,335,725	1,213,681	1,296,250
Myanmar	949,670	1,029,460	1,053,720	1,132,340	1,228,710	1,375,670
Philippines	1,816,067	1,902,531	2,036,552	2,073,994	2,106,543	2,161,537
Singapore	3,342	2,769	2,085	2,173	1,920	3,103
Thailand	2,631,474	2,643,728	2,651,277	2,636,412	2,615,523	2,579,025
Viet Nam	1,481,175	1,575,640	1,647,233	1,733,434	1,791,100	1,816,100
Total for SEA	**12,129,018**	**12,552,305**	**13,119,189**	**13,294,117**	**13,426,426**	**13,762,586**
World's Total	**85,433,786**	**85,797,889**	**82,821,495**	**87,032,941**	**85,787,539**	**83,081,146**

Source: FAO Fishstat Plus (2008)

Considering therefore that aquaculture is an important factor that could contribute to food security in the region as shown in **Table 1**, its sustainable development was highly emphasized during the ASEAN-SEAFDEC Millennium Conference in November 2001. Thus, in the Resolution on Sustainable Fisheries for Food Security for the ASEAN Region (SEAFDEC, 2001) which was adopted during the Millennium Conference, the Ministers of the ASEAN-SEAFDEC Member Countries resolved to *"increase aquaculture production in a sustainable and environment-friendly manner by ensuring a stable supply of quality seeds and feeds, effectively controlling disease, promoting good farm management, and transferring appropriate technology."* This declaration was also clearly specified and spelled out in the accompanying Plan of Action also adopted in November 2001, which specifically indicated among others the need to *"improve capabilities in the diagnosis and control of fish diseases within the region by developing technology and techniques for disease identification, reliable field-side diagnosis and harmonized diagnostic procedures, and establishing regional and inter-regional referral systems, including designation of reference laboratories and timely access to disease control experts within the region."* Moreover, the Plan of Action also specified the need to *"reduce risks of negative environmental impacts, loss of biodiversity, and disease transfer by regulating the introduction and transfer of aquatic organisms"*, and *"formulate guidelines for the use of chemicals in aquaculture, establish quality standards and take measures to reduce or eliminate the use of harmful chemicals."*

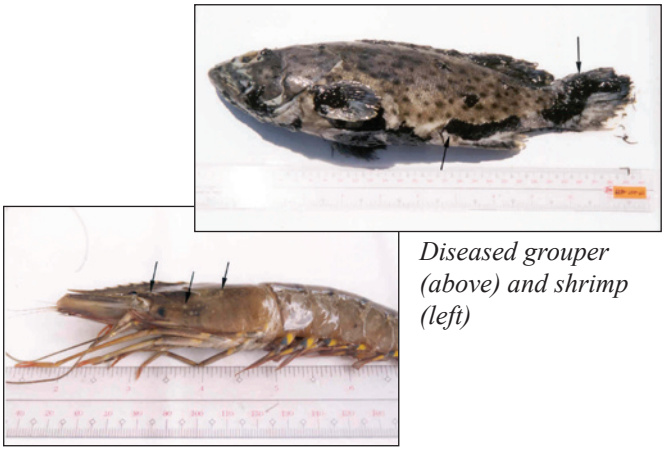
In the last two decades, aquaculture in Southeast Asia has grown very rapidly. However, due to irresponsible introduction of aquatic species that were carriers of pathogens, a large number of infectious diseases have emerged threatening the sustainability of aquaculture in the region. Furthermore, the occurrence of aquatic diseases has not only led to low production but has also threatened food security and raised alarming environmental concerns. It is for this reason that SEAFDEC intensified the implementation of a regional program on fish disease. As early as 2000, SEAFDEC through its Aquaculture Department (AQD) based in Iloilo, Philippines and with funding support from the Trust Fund Program of the Government of Japan's Fisheries Agency (JTF) implemented the Regional Fish Disease Program which included the five-year activity on the Development of Fish Disease Inspection Methodologies for Artificially-bred Seeds under Phase I that covered research, hands-on training, annual meetings, and workshops. This was followed by Phase II starting in 2004, which focuses on the Development of Fish Disease Surveillance System.

Development of Diagnostic Methods for Important Viral Diseases of Aquatic Animals

As the main thrust of Phase I of the SEAFDEC Regional Fish Disease Program, diagnostic methods have been developed to ensure healthy and wholesome trading of aquaculture products in the Southeast Asian region. The implementation of Phase I was also an opportune time to prevent the spread and control of an emerging viral disease of common carps known as *koi herpes virus* (KHV) which almost devastated carp production in the region. The timely efforts of SEAFDEC to address such concern had ensured the sustainability of carp culture, a major economic livelihood in many Southeast Asian countries.

The main activities under Phase I were implemented to address the concerns related to the reported viral diseases in cultured shrimps and fishes in Southeast Asia. Nagazawa (2004) reported that the white spot syndrome virus (WSSV) of the black tiger shrimp (*Penaeus monodon*) and the viral nervous necrosis (VNN) in marine fishes are two well known examples of such viral diseases affecting the aquaculture industry in the region. WSSV was in fact one of the root causes of the devastation of the shrimp culture industry that brought acute economic slow-down in Southeast Asia in the 90s. During the implementation of Phase I, diagnostic methods such as the polymerase chain reaction (PCR) were standardized for the WSSV (de la Peña *et al*., 2007) while methods to prevent and control VNN infection in marine fish hatchery have also been developed (de la Peña *et al*., 2005). In addition, husbandry techniques (e.g. use of live bacteria or probiotics and "green water" culture system) to control the luminous vibrosis caused by *Vibrio* spp. such as *Vibrio harveyi*, a common bacterial disease that has also heavily affected shrimp aquaculture in the Southeast Asian region,

Analysis of shrimp virus (above); and on-site monitoring of fish diseases (left)



Diseased grouper (above) and shrimp (left)

On-site training on carp KHVD and Spring Viraemia of Carp (SVC) detection conducted by AQD in Vietnam

were also developed as alternatives for chemotherapy(de Castro-Mallare *et al*., 2005).

Moreover, diagnostic methods have also been standardized for monodon baculovirus (MBV) and hepato-pancreatic parvovirus (HPV) in shrimps, and other aquatic diseases (Catap *et al*., 2003; Catap and de la Peña, 2005; de la Peña *et al*., 2008). Results from the standardized diagnostic and husbandry methods for disease control have been disseminated to the region through training and massive information dissemination.

The first outbreak of the viral disease in koi and common carp (*Cyprinus carpio*) known as the koi herpes virus disease (KHVD) was reported to have caused mortalities in carps in Indonesia in early 2002 and in Japan in 2003. With potential threats of spreading in other Southeast Asian countries, SEAFDEC through the Regional Fish Disease Program initiated strategies for the prevention and control of the KHVD. Kanazawa (2005) cited that in 2003, the losses incurred by Indonesia due to the KHVD was more than US Dollars 15 million, and considering that common carp is an important source of protein in the rural areas in Southeast Asia, it has become necessary for AQD to conduct studies on KHVD taking into account its high virulence and devastating impact on the freshwater aquaculture sector. Lio-Po (2004, 2005) cited that the results of the studies on KHVD conducted at AQD with funding from JTF have provided basic data on the status of the disease in the region and led to the prevention of the transboundary movement of KHVD in Southeast Asia.

E-learning on Principles of Health Management in Aquaculture

Since 1988, AQD has been conducting classroom-based face-to-face training courses on health management in aquaculture on a regular basis at its main station in Tigbauan, Iloilo, Philippines. Later in the early 2000s, the teacher-student face-to-face setting had been changed into a distance-learning mode, which AQD considered more convenient and practical for a learner to acquire knowledge and skills in health management at his own place and at his own time.

A learner only has to have an Internet access to communicate with highly qualified instructors or with fellow learners. This new learning experience via information technology was developed for the AQD AquaHealth Online, which covers up-to-date knowledge on fish and crustacean diseases, the causal organisms and the methods of disease prevention and control (Lavilla-Pitogo and Torres, 2004). Targeting full-time working professionals, AquaHealth Online aims to introduce the principles of health management in aquaculture, and is envisaged that by the end of the course, online participants should be able to recognize diseased shrimps and fish, identify the cause(s) of the diseases, explain how the diseases develop, apply preventive and control measures to lessen the risks posed by the diseases, and use appropriate techniques for the preparation of samples for disease diagnosis. AquaHealth Online requires that participants should have basic knowledge of written English and competency in using computers and browsing the internet.

Lavilla-Pitogo and Torres (2004) cited that the shrinking fellowship and travel funds necessitated a shift in AQD's training paradigm. Thus, the AquaHealth Online was developed to train a large pool of geographically dispersed participants at minimum costs. Since its first session in 2002, AquaHealth Online has trained about 150 e-learners not only from Southeast Asia but also from other regions in the world. Based on the feedbacks from the e-learners, AquaHealth Online has proved that a state-of-the-art online course can be as effective as the face-to-face training.

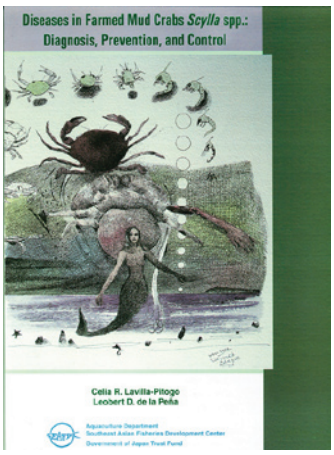
Fish Disease Surveillance System

Phase II of the Regional Fish Disease Program focuses on the Development of Fish Disease Surveillance System in

Southeast Asia to assist the Southeast Asian countries in their efforts in fish health prevention and management. Through this project, a network of the region's resources and facilities for fish health diagnosis has been established while human capacity building has been enhanced. While implementing this project, AQD has continued to refine the diagnostic methods to be able to develop new prevention methods for aquatic animal diseases. More importantly, a surveillance system for important viral diseases for shrimps in the region has been instituted.

As a result, the countries have developed a well-coordinated network for the timely and efficient reporting on any outbreak of any aquatic disease in the region as exemplified in the reporting of KHVD which spared the region's freshwater aquaculture sector from total economic collapse. As one of the most significant outcomes of this project, the countries in the region can now boast of its regionally-recognized reference laboratory for specific aquatic diseases.

In order to review the emerging fish diseases and to keep the region abreast on the advances in pathogenesis, diagnosis, epidemiology, and surveillance of emerging diseases of aquatic animals the International Workshop on Emerging Fish Diseases in Asia was convened by SEAFDEC in December 2007 in Bangkok, Thailand. Attended by more than 70 participants from 17 countries including the Southeast Asian region, the information obtained from the Workshop has largely contributed to the promotion of responsible aquaculture in the region. Moreover, the knowledge gained by Southeast Asian countries on newly emerging aquatic diseases could boost their efforts in preventing the occurrence and spread of any aquatic diseases. This would then ensure that aquaculture products from the region are safe and wholesome for human consumption. The proceedings of the workshop would be published in September 2009.



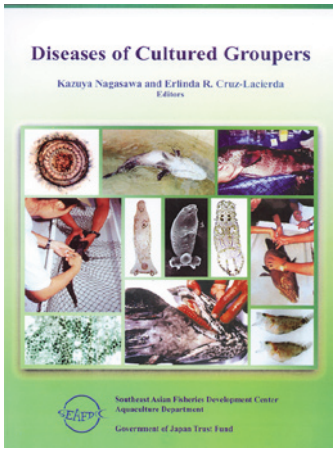
Publications relevant to fish diseases produced by AQD under the projects supported by the Japanese Trust Fund

Monitoring Residual Chemicals in Aquaculture Products

Considering that the presence of chemical residues in aquaculture products poses threats to human health, SEAFDEC through the Regional Fish Disease Program has developed and standardized detection methods for residual chemicals such as pesticides and antibiotics in aquaculture products. This is aimed at securing safe and healthy aquaculture products from the Southeast Asian region.

The expansion of aquaculture farming activities over the years has made the health of the culture animals under constant threat from bioagressors such as viruses, bacteria, parasites and fungi. In an effort to control the occurrence of such bioagressors, many farmers use antibiotics and other chemicals without knowing that some could be toxic to humans and pose danger to the wellness of the environment. Improper use could also induce the development of resistant pathogens in the cultured aquatic species, the human consumers and the environment (Platon *et al*., 2007).

With the cooperation of the Singapore-based SEAFDEC Marine Fisheries Research Department (MFRD), studies have been conducted to develop detection methods of residual antibiotics in aquaculture products. Oxolinic acid (OXA) and tetracycline (TC) are the most extensively used antibiotics in aquaculture and in order to determine the residue levels of OXA and TC in aquaculture products, high performance liquid chromatography methods had been developed (Tan *et al*., 2005). Moreover, a compilation of the methods for chloramphenicol and nitrofuran residue testing were prepared by MFRD and AQD and disseminated to the region's fish disease laboratories (Ruangpan and Tendencia, 2004; Borlongan and Ng, 2004). Furthermore, evaluation methods for residual chemicals in aquaculture products have been established to secure the safety of aquaculture products while the use of antibiotics in the region's aquaculture industry has been closely monitored (Borlongan, 2005; Ruangpan and Pradit, 2005).



Conclusion and Way Forward

Through the R&D activities of the SEAFDEC Regional Fish Disease Program and with the knowledge learned and experiences gained from the program activities, the countries in the region would be able to continue their efforts in controlling aquatic diseases to safeguard the quality of their products that are meant not only for domestic consumption but also for export. SEAFDEC through the JTF Regional Fish Disease Program would continue to provide the means in order that the goals and objectives of the countries are achieved thus, ensuring that aquaculture products from the region are safe for human consumption and continue to satisfy standard quality criteria.

The occurrence of diseases in aquaculture is attributed to bad management practices that bring about deteriorated culture conditions, and in order to prevent disease outbreak some innovations have been adopted in the region including the installation of effluent reservoirs which was found effective in controlling viral diseases (Platon *et al*., 2007). The number of recommendations for controlling fish diseases in aquaculture systems which Platon *et al*. (2007) have listed down should be considered specifically in the further development and refinement of the various methods and techniques for fish disease prevention and control. After all, many preventive measures are now being advanced that could inhibit the use of chemical inputs in aquaculture.

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Could MCS Serve as a Tool in Achieving Sustainable Fisheries in Southeast Asia?

Bundit Chokesanguan

Monitoring, Control and Surveillance (MCS) was first defined by FAO in 1981, where Monitoring is the continuous requirement for the measurement of fishing effort characteristics and resource yields, Control is the regulatory conditions under which the exploitation of the resources can be conducted, and Surveillance is the degree and types of observations required to maintain compliance with regulatory controls imposed on fishing activities.

The fisheries sector in the Southeast Asian region is generally characterized as multi-gear and multi-species and mostly small-scale. The contribution of small-scale fisheries to the total landing varies depending on the status of fisheries development in the respective countries. In Indonesia and the Philippines for example, the contribution of small-scale fisheries to their total fish landings is relatively higher than that of Thailand, where industrial fisheries have grown faster than in the other ASEAN countries. Small-scale fisheries, by and large, supply fish for local consumption, while most of the large-scale fisheries supply the export outlets. In this region, industrial fisheries were developed in addition to the traditional fisheries after 1960s, following the modernization of technologies. In general however, the region's major fishing sector in terms of number of people involved is still categorized as small-scale, coastal and subsistence fisheries. Although the specific structure differs from country to country, still a majority of the fisheries in the region can be categorized as non-industrial and small-scale traditional fisheries.

The rapid development of fisheries in the region has resulted in increased landings and exports in a relatively short period of time. This development, however, has also brought about over-exploitation of the coastal resources, which very often is followed by conflict among the resources users. To cope with such problems, governments of many countries strengthened their fisheries department by instituting fisheries management units. MCS is a component of fisheries management which has been promoted by many countries in the region in order to achieve sustainable fisheries.

MCS and the Structure of Fisheries in the Southeast Asian Region

The 1993 clarification and amplification of the MCS definitions concluded in Ghana took note of the consequences of not including some of the activities in MCS. Thus, the revised definition of MCS (FAO, 2003) stated: *'**Monitoring**' includes the collection, measurement and analysis of fishing activity including, but not limited to: catches, species composition, fishing effort, discards, area of operations, etc. This information is primary data that fisheries managers use to arrive at management decisions. If this information is unavailable, inaccurate or incomplete, managers will be handicapped in developing and implementing management measures. '**Control**' involves the specification of the terms and conditions under which resources can be harvested. These specifications are normally contained in national fisheries legislation and other arrangements that might be nationally, sub-regionally, or regionally agreed. The legislation provides the basis for which fisheries management arrangements, via MCS are implemented. For maximum effect, legislation should be flexible (to cater for different and changing circumstances) and easily enforceable; and '**Surveillance**' involves the checking and supervision of fishing activity to ensure that national legislation and terms, conditions of access, and management measures are observed. This activity is critical to ensure that resources are not over exploited, poaching is minimized and management arrangements are implemented.*

These latter FAO definitions and interpretations of MCS have been adopted in the Southeast Asian region, and to some extent adjusted and commonly used by fisheries personnel. Thus, the definition of MCS arising from the Southeast Asian context states that: **monitoring** is the collection, measurement and analysis of fishing and related activities, including - but no limited to – catch, species composition, fishing effort, by-catch, discards, areas of operation; **control** is the establishment of measures consisting of the specification of the terms and conditions under which resources can be harvested; and **surveillance** is the checking and supervision of fishing and related activities to ensure that national legislation and terms, conditions of access, and management measures are observed.

The people in the Southeast Asian Region have greatly and historically depended on fish for their diet. Therefore, fisheries can not be replaced by any alternate system to secure the protein requirements in food including livestock products. Fisheries in this region are typically tropical and exploiting a multitude of species, so that the methods to catch fish are in great number in terms of traditional fishing gears and practices, fish processing methodologies, and fish marketing systems that have traditionally and greatly diversified. Based on the regional fisheries structure, it is not simple to define such terms as coastal fisheries and industrial fisheries due to the different legal definitions applied by each country in the region. Nevertheless, for better understanding

in the absence of their definitions, the Fishing Zones and the Classifications of Small-scale Fisheries and Large-scale Fisheries in the Southeast Asian region are shown in **Box 1** and **Box 2**, respectively.

Implementation of MCS in the Southeast Asian Counties

Among the Southeast Asian countries, Indonesia has the largest EEZ and numbers of fishers followed by Myanmar, Philippines and Vietnam (**Box 3**). However, the importance of the fisheries in the region is not directly related to numbers of fishers and size of EEZ as can be seen in Thailand, which has comparatively smaller EEZ (176,540 km^2) than Indonesia's 2.9 million km^2 and Philippines' 0.3 km^2. Thailand, which puts more effort in food security as well as promoting export including value-adding, had a total volume of fish production in 2006 at about 4.2 million mt, which was third after Indonesia's almost 7.0 million mt and Philippines' 4.4 million mt (**Table 1**). Much of Thailand's catch is from the fishing grounds outside the waters of Thailand, while Malaysia, Myanmar and the Philippines are still starting to fish further from their shores and building up larger offshore capacities. Considering that inland fisheries also play an important role in ensuring food security in many countries in the region, an MCS could also be designed for the region's inland fisheries sub-sector. In any case, countries in the region should take very cautious strides in expanding to offshore fisheries considering the increasing trend of fuel prices and the fact that there is no scientific evidence that more production could be derived from the deeper waters than the shallow areas (Kato, 2008).

Cambodia

Fisheries management in Cambodia is the responsibility of its Fisheries Administration under the Ministry of Agriculture, Forestry and Fisheries. MCS for the Cambodian marine and freshwater fisheries is an extremely difficult task to undertake due to more than two decades of war and concomitant anarchy. At the same time, many institutions have been involved in the management of the sector, legally and abusively, making it difficult for fishery planners and managers to perform their tasks well and to better arrange for community participation.

Since the local fishers are first and foremost the immediate beneficiaries of the fisheries resources, the participation of the local communities in planning, implementing, monitoring and evaluation is an absolute necessity in order to better strengthen MCS activities. The major constraints in the country's fisheries MCS include: (1) lack of qualified and skilled staff; (2) budgetary limitations for equipment and materials; (3) open access nature of the fisheries as it is very difficult to clearly separate small-scale from medium-scale in actual practice; and (4) lack of community participation and involvement in fishery conservation, protection and management.

Indonesia

Basically Indonesia's MCS system has been established to comply with the new regime of EEZ waters under the jurisdiction of the country's coastal states, but in broader term, its MCS system is relevant to dealing with fisheries resources management as a whole. Indonesia has adopted the MCS system, and gradually the concept and its implementation has been improved, according to the country's capabilities in terms of institutional requirements, manpower, coordination, etc. Particularly in relation to surveillance and enforcement in Indonesia, there are a number of institutions involved that include its

Box 1. Fishing Zones of Countries in Southeast Asia

Countries	Fishing Zone 1	Fishing Zone 2	Fishing Zone 3	Fishing Zone 4
Brunei Darussalam	From shore line out to 3 nautical miles (nm)	From 3 to 20 nm	From 20 to 45 nm	From 45 nm to EEZ limit
Cambodia	From shoreline out to 20 m depth	From 20 m depth to EEZ limit		
Indonesia	From shore line out to 3 nm	4 nm from the outer limit of first fishing zone or 7 nm from shore.	5 nm from the outer limit of second fishing zone or 12 nm from shore	More than 12 nm from the shore
Malaysia	From shore line out to 5 nm	From 5 to 12 nm	From 12 to 30 nm	From 30 nm to EEZ limit
Myanmar	From shoreline out to 5 nm in the northern area, 10 nm in the southern area.	From outer limit of first fishing zone to EEZ limit		
Philippines	From shore line our to 15 km	From 15 km to EEZ limit		
Thailand	From shore line out to 12 nm	From 12 nm to EEZ limit		
Vietnam	From shore line to 30 m depth in northern and southern areas to 50 m depth in central areas	From 30 to 50 m depth the EEZ limit		

Source: *SEAFDEC (2000 and 2003)*

Box 2. Classifications of Small-scale Fisheries and Large-scale Fisheries

Countries	Small-scale Fisheries	Large-scale Fisheries
Brunei Darussalam	*Small-scale/Artisanal fisheries:* Operating in all Zones but concentrating in Zone 1	*Industrial Fisheries:* a) Trawlers less than 350HP operating in Zone 2 b) Purse seiners less than 20m LOA operating in Zone 2 c) Trawlers with 350-550HP operating in Zone 3 d) Purse seiners with 20-30m LOA operating in Zone 3 e) Purse seiners more than 30m LOA operation in Zone 4
Cambodia	*Coastal Fisheries:* Small-scale fisheries with/without engine (from 5 HP to 50HP) operating in Zone 1	*Commercial Fisheries:* Vessels more than 50 HP operating Zone 2
Indonesia	*Small-scale Fisheries:* a) Outboard engines <10 HP or <5GT operating in Zone 1. Trawls, purse seine and gill net are not allowed, except for purse seines with a head rope <120 m b) Inboard engines <50 HP or < 25 GT operation in Zone2. Trawl and purse seine are not allowed, except purse seine with a head rope <300 m.	*Industrial Fisheries:* a) Inboard engine < 200 HP or 100 GT operating in Zone 3, Purse seine is not allowed except those with a head rope < 600 m. b) All fishing boats and fishing gear operating in Zone 4
Malaysia	*Traditional Fisheries:* Small-scale fisheries using traditional fishing gears (i.e. other than trawls and purse seine) with boats less than 10 GT operating in all Zones concentration in Zone 1.	*Commercial Fisheries:* Medium and large scale fisheries using commercial fishing gears such as trawls and purse seines. a) With boats less than 40 GT operating in Zone 2. b) With boats from 40 GT to 70 GT operating in Zone 3. c) With boats above 70 GT operating in Zone 4.
Myanmar	*Coastal Fisheries:* Boats of less than 30 feet or using less than a 12 HP engine operating in Zone 1	*Industrial Fisheries:* Boats more than 30 feet long or using more than 12 HP engines operating in Zone 2
Philippines	*Municipal Fisheries:* Small-scale fisheries with boats of less than 3 GT that are allowed to operate in Zones 1 and 2	*Commercial Fisheries:* a) Small-scale commercial fisheries: from 3.1 to 20 GT boats operation in Zone 2; can also operate within 10.1 to 15 km (within Zone 1) if authority in granted by the concerned local government unit (LGU) b) Medium-scale commercial fisheries: from 20.1 to 150 GT operating in Zone 2; can also operate within 10.1 to 15 km (within Zone 1) if authority is granted by the concerned local government unit (LGU) c) Large-scale commercial fisheries: more than 150 GT operating in Zone 2.
Thailand	*Small-scale Fisheries:* With boats of less than 5GT operating in Zone 1	*Large-scale Fisheries:* With boats of more than 5 GT operating in Zone 2
Vietnam	*Small-scale Fisheries:* Boats with no engine and with engine but less than 40 HP	*Large-scale Fisheries:* Boats with engine more than 40 HP

Source: *SEAFDEC (2000 and 2003)*

Box 3. Coastal and Marine Ecosystems of the Southeast Asian Countries

Countries	Length of Coastline (km)	Area of Continental Shelf (km^2)	Territorial Sea, up to 12 nm (km^2)	Exclusive Economic Zone (km^2)
Cambodia	1,127	34,646	19,918	55,000
Indonesia	95,181	1,847,707	3,205,695	2,914,978
Malaysia	9,323	335,914	152,367	198,173
Myanmar	14,708	216,379	154,778	358,495
Philippines	33,900	244,493	679,774	293,808
Thailand	7,066	185,351	75,876	176,540
Vietnam	11,409	352,420	158,569	237,800

Source: *EarthTrends (2003)*

Table 1. Total fish production of the Southeast Asian countries with production from capture fisheries

Countries/Production	2001	2002	2003	2004	2005	2006
Brunei Darussalam (Total)	1,696	2,215	2,386	3,136	3,108	3,100
Inland Capture Fisheries	1,578	2,044	2,221	2,417	2,390	2,390
Total Capture Fisheries	1,597	2,058	2,226	2,428	2,400	2,400
Cambodia (Total)	445,700	424,432	390,657	343,332	426,000	532,700
Inland Capture Fisheries	43,200	45,882	55,607	55,817	60,000	60,500
Total Capture Fisheries	428,200	406,182	364,357	305,817	384,000	482,500
Indonesia (Total)	5,354,134	5,516,206	5,920,373	6,121,296	6,828,020	6,989,033
Inland Capture Fisheries	3,967,145	4,074,066	4,383,158	4,321,805	4,406,559	4,468,010
Total Capture Fisheries	4,277,385	4,379,055	4,691,814	4,652,684	4,703,927	4,769,150
Lao PDR (Total)	81,000	93,156	94,700	94,700	107,800	107,800
Inland Capture Fisheries	31,000	33,440	29,800	29,800	29,800	29,800
Malaysia (Total)	1,415,834	1,463,625	1,483,324	1,542,071	1,424,097	1,498,732
Inland Capture Fisheries	1,235,367	1,276,185	1,287,336	1,335,725	1,213,681	1,296,250
Total Capture Fisheries	1,238,813	1,279,635	1,291,164	1,339,844	1,218,263	1,300,415
Myanmar (Total)	1,309,146	1,474,460	1,595,870	1,986,960	2,217,470	2,581,780
Inland Capture Fisheries	949,670	1,029,460	1,053,720	1,132,340	1,228,710	1,375,670
Total Capture Fisheries	1,187,880	1,284,340	1,343,860	1,586,600	1,732,250	2,006,790
Philippines (Total)	3,172,368	3,372,036	3,617,640	3,931,369	4,144,626	4,414,310
Inland Capture Fisheries	1,816,067	1,902,531	2,036,552	2,073,994	2,106,543	2,161,538
Total Capture Fisheries	1,951,912	2,033,642	2,169,136	2,214,341	2,248,778	2,322,036
Singapore (Total)	7,785	7,796	7,109	7,579	7,837	11,676
Total Capture Fisheries	3,342	2,769	2,085	2,173	1,920	3,103
Thailand (Total)	3,648,095	3,797,124	3,914,133	4,099,595	4,118,483	4,162,096
Inland Capture Fisheries	2,631,474	2,643,728	2,651,277	2,636,412	2,615,523	2,579,025
Total Capture Fisheries	2,833,974	2,842,428	2,849,724	2,839,612	2,814,270	2,776,295
Vietnam (Total)	2,332,856	2,530,639	2,823,607	3,108,105	3,397,200	3,647,627
Inland Capture Fisheries	1,481,175	1,575,640	1,647,233	1,733,434	1,791,100	1,816,100
Total Capture Fisheries	1,724,758	1,802,598	1,856,105	1,879,488	1,929,900	1,959,900

Source: FAO Fishstat Plus 2008

Directorate General of Fisheries, Navy, Department of Sea Communication, etc.

However, as MCS system is a new concept in Indonesian fisheries management, some teething problems have arisen, and as the legal aspects of the MCS system are not yet fully ready, thus hampering effective MCS implementation. Being a new concept, the MCS system is yet to be fully understood by most of the officials concerned and the stakeholders. Lack of trained staff capable of implementing this system as well as lack of facilities particularly at sea such as fisheries inspection vessels and operating budget, constrained the implementation of the MCS system in the country. So there is need to enhance the supporting components including staff, facilities and budget, and also introduce a systematic framework or mechanism for coordination in order to realize the objectives of the MCS system.

Malaysia

The MCS system of Malaysia has come a long way from the basic need of fisheries management for territorial/coastal waters, and evolving to cope with new obligations and international concerns, especially those pertaining to management, conservation and utilization of fisheries resources in the EEZ. The MCS is mainly done by the Department of Fisheries (DOF) Malaysia, although other agencies are also involved, including the country's marine policy, navy, and to a certain extent some agencies under the Ministry of Science and Environment. The MCS program in Malaysia is relatively advanced compared to its neighboring countries. It embraces several activities, including those dealing with the collection of information on catches by vessels, which is an important data input for stock assessment, and which in turn provides support to the formulation of management measures. Furthermore, MCS operations also offer potential assistance in search and rescue operations for missing fishers or boats. MCS in Malaysia

was not conjured up overnight, but was mooted years back, while fisheries management and conservation measures were formulated and implemented. However, major structural changes were made and enhancements added to cope with the changing fishing industry itself, and also to accommodate the country's obligations under the United Nations Convention on the Law of the Sea (UNCLOS) and to reflect international concern. While continuous efforts have been made to improve MCS, Malaysia is certainly too enthusiastic to claim that its MCS system is now the most effective or efficient. However, the country also recognizes that much has yet to be done, especially in consolidating the effectiveness of MCS itself through the years. The various measures taken ostensibly under the auspices of MCS have to be looked at in a different light, in a more binding way, to allow the concept of MCS to mould these measures into a powerful integrated system, so that, together, it becomes a powerful tool in fisheries management.

Myanmar

Fisheries in Myanmar could address the diversity in both marine and fresh water fisheries. In accordance with its MCS system, the Department of Fisheries (DOF) of Myanmar is mainly concerned with controlling the authorized operation of fishing vessels in Myanmar waters. It is the general view of its Fisheries Department that recently enacted laws are working satisfactorily, but also admitting that unauthorized fishing activities are still extensively practiced. Its fisheries legislation has been enacted and been adjusted in conformity with provisions of the UNCLOS specifically regarding the sharing of the surplus of fishery resources with neighboring states. However, the surveillance and control of vast areas of marine territorial waters is still difficult and violations of laws have sometimes been discovered. In its future action, the Fisheries Department is seeking external assistance for upgrading their MCS capabilities, improving education programs and developing aquaculture as an alternative to capture fisheries.

Philippines

Over-fishing and illegal fishing are the major issues and threats in Philippine fisheries. The use of destructive fishing methods (i.e., dynamite, cyanide fishing and the use of fine mesh net fishing gear) has resulted in rapid habitat degradation and decline of the fishery stocks. The country's MCS system was designed to address these fisheries issues as well as other coastal and oceanic concerns. It was developed for the main purpose of providing a credible deterrence to violation of fishery laws and regulations, and preventing unlawful foreign and domestic fishing activities in Philippines waters. In addition, information on fishing effort, catches, vessel traffic, and such other related data could very well be used as basis for the formulation of national policies and laws, and in making strategic and tactical decisions regarding ocean planning and management, including enforcement. The design of the country's MCS system has been completed and approved by the Secretary of the Department of Agriculture (DA) and endorsed by the President in 1995, for implementation under DA's leadership. However, despite initial implementation using external and some internal funds, the implementation of the whole system has advanced at a very slow pace. Currently, the activities are concentrated in the near shore areas. Offshore activities, particularly surveillance, rely heavily on assistance extended by the country's Department of National Defense (DND) until such time that the necessary equipment are purchased for this purpose. Moreover, the Philippines also has the most progressive programs for public awareness and introduction of participatory management for their coastal areas.

Thailand

Basically, the coastal and marine fisheries in Thailand generate much more serious problems than inland fisheries. These problems include the depletion of fish stocks, over fishing, the use of destructive fishing gears, conflicts between many resource users, deterioration of coastal and marine environment, pollution, etc. Therefore the Department of Fisheries (DOF) of Thailand has to place more emphasis on coastal and marine fisheries. Key regulations are given high priority in coastal areas, which include the prohibition of fishing in the areas closed for three months during the spawning season of Indo-Pacific Mackerel in the Gulf of Thailand, and similarly the closed season in the Andaman Sea. The fisheries patrol boats have to patrol and monitor the 3 km line along the coasts of Thailand all year round in order to deter trawlers and push-netters from violating the regulation. The inshore area of the 3 km line is reserved for small-scale fisherman.

The areas closed for three months annually in the Gulf of Thailand during the spawning season of the Indo-Pacific Mackerel and in the Andaman Sea for other species require special attention. Some types of fishing gears are prohibited, such as otter-board and pair trawls, purse seines, and Chinese purse seine with mesh less than 4.7 cm. During the closed season, the DOF establishes a special task force to monitor and strictly enforce the law. Apart from using patrol boats, air craft are also used for MCS, in addition to the use of other technology and equipment such as radar, satellite system, etc. The DOF realizes that monitoring and surveillance are costly due to the large cost involved in acquiring patrol boats, purchasing fuel, hiring staff, etc. Therefore other measures have been sought to encourage the fisherman to comply with the fishery laws and regulations. These included campaigns aimed to increase the fishermen and public awareness by providing information regarding fisheries conservation and management, fisheries laws, regulations and enforcement to fishermen and their family members; establishing voluntary groups to help conserve fishery resources; and training student groups in

fisheries conservation and management. It is expected that these measures would help increase the awareness of all stakeholders regarding responsible fisheries.

Vietnam

The marine resources of Vietnam are characterized by their multi-species nature, with small schools not concentrating in large exploitation areas and with clear variation. In addition, the characteristics of the resource distribution indicated that the bulk is concentrated in shallow waters, inshore from the 50 m depth contour. Due to such distribution characteristics of the fishery stocks in Vietnamese waters, fishing activities are concentrated in the 30 to 50 m depth zone, so that MCS of fishing activities in Vietnam is essentially inshore in nature. This led to the establishment of the country's Department of Protection of Marine Resources (DPMR) which operates in coastline localities. Equipped with small boats, its Sub-departments have proceeded with MCS of marine aquatic resources exploitation and legal enforcement. However, the capacity of the DPMR and its Sub-departments for protection remains too small compared with the required task. In particular, the boats available for patrol work are small and few, so control and inspection are constrained. Moreover, the attention to protect the resource along the coast is still very concentrated. Thus, there are near future plans and directions to manage their coastal fisheries through many measures such as continue coastal areas planning, continue research programs, strengthen the protection of fisheries resource in coastal areas, enhance people's knowledge and social/cultural life of fishing communities, improve fisheries law, strengthen monitoring and enforcement, etc.

MSC Focus on Combating IUU Fishing

Illegal, Unreported and Unregulated (IUU) fishing can take place in all capture fisheries, whether within national jurisdiction or in the high seas. Efforts to conserve and manage fish stocks are undermined by IUU fishing and can lead to the collapse of a fishery or can seriously impair efforts to rebuild fish stocks that have already been depleted. This may lead to the loss of both short- and long-term social and economic opportunities, and could have negative impact on food security. Every country in the Southeast Asian region is always confronted by increasing pressure on their fisheries resources from illegal fishing. In many cases, IUU operation is more related to the lack of MSC management.

Nevertheless, countries in Southeast Asia should now focus on developing preventive measures in achieving sustainable fisheries rather than on the fisheries management that focuses on mitigating resource conflicts. Such measures could include regulating the number of fishing boats and overcapacity as well as an effective right-based fisheries system. The IUU concept, with more focus on the I (illegal fishing), undermines national and regional efforts to conserve and manage fish stocks and, as a consequence, inhibits progress towards achieving the goals of long-term sustainability and responsibility as set forth in the Code of Conduct for Responsible Fisheries. Moreover, IUU fishing greatly disadvantages and discriminates those fishers that act responsibly, honestly and in accordance with the terms of their fishing authorizations. This is a compelling reason why IUU fishing must be dealt with expeditiously and in a transparent manner. If IUU fishing is not curbed, and if IUU fishers target vulnerable stocks that are subject to strict management controls or moratoria, efforts to rebuild those stocks to healthy levels will not be achieved. The regional plan of action (RPOA) to promote responsible fishing practices including combating IUU fishing in the region have already been drafted during the workshop held in Bali, Indonesia in March 2008 (**Box 4**).

Conclusion

The problem of the coastal and marine fisheries in the region lies in the depletion of fish stocks, over fishing, conflicts between many resource users, ignorance, violations of laws and regulations by fishermen, etc. Certain countries are making strenuous efforts to improve their fisheries management and improve their MCS systems. Some are successful while some have failed, which might be due to the nature of the fishery resources being a common property, lack of strict implementation of limited entry policy and other policies, shortage of manpower and equipment to enforce the laws, lack of coordination between the government agencies concerned, etc. As in the case of Thailand, during the past decade the government has put more efforts into this effort by allocating more budget for MCS, but nevertheless there are still some fishermen violating the laws. Therefore, it can be understood that no MCS activities will be successful if there is absence in understanding and acceptance by the fishers of the rationale behind the MCS actions being implemented. Other measures are also needed to help increase compliance from the fishermen. Thus, in combination with MCS activities, such measures as establishing community-based fishery management, providing information to increase awareness among fishermen and their family members of fisher conservation and responsible fisheries, establishing voluntary groups, providing training programs for students, etc. are still necessary.

It is expected that these measures will help encourage fishermen to operate more responsibly in the long run. Eventually, MCS as defined under the Southeast Asian context could be one of the important fisheries management tools in order to achieve sustainable fisheries in the region.

Box 4. Recommendations and plan of action to promote responsible fishing practices (March 2008 Bali Workshop)

- Formalize a MCS sub-regional network,
- Identify and assess the key MCS gaps within the sub-region,
- Further explore processes to develop licensing, authorization and vessels ID for fishing and support vessels,
- Develop cooperative surveillance exercises,
- Develop sub-regional hot pursuit guild-lines,
- Coordinate and integrate all relevant national agencies in MCS activities,
- Focus on mechanisms to improve the collection and analysis of information on fishing vessels, catches, trans-boundary, market destinations of catches and operation nature and extent of all fishing activities, and
- Strengthen the institution and human capacity building across the region.

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The Role of Crab Bank System in Securing Fisheries Livelihood and Resources Conservation and Management

Phattareeya Suanrattanachai, Thitiporn Suppanirun, Seiichi Etoh and Virgilia Sulit

In the implementation of the community-based fisheries resources management (CBRM) approach under the Integrated Coastal Resources Management (ICRM) projects implemented by SEAFDEC and its collaborating partners in Thailand (ICRM-PD), Malaysia (ICRM-PL) and Cambodia (ICRM-SV), the Crab Bank System has inspired the local people to ensure that the crab resources are protected and conserved in a sustainable manner (Etoh, 2008). The local people in ICRM project sites considered the Crab Bank System as means to sustain and conserve the crab resources in their fishing areas. The promotion of the Crab Bank System has also enhanced the awareness of the local fishers on the need to manage their crab resources to improve their livelihoods. Two major types of Crab Bank System have been promoted in the ICRM projects: the system improved in Chumphon under the ICRM-PD and the Japanese System (**Box 1**), with improvements and innovations introduced and adopted by the local fishers.

In Chumphon Province, Thailand, the fishers observed that the blue swimming crab resources had rapidly declined because of the increasing number of collapsible crab traps. The fishers also tend to catch all sizes of crabs regardless of whether these are non-marketable or gravid or fertilized. Thus, the Crab Bank System was developed and introduced as an activity of the ICRM-PD to increase and enhance the amount of crab recruitment.

Under this system, the fishers operating crab traps donate the small-sized and gravid crabs to the project's crab bank (which is actually a crab floating cage). After the gravid crabs have spawned in the cages, the eggs are released to the sea while the spent crabs are sold to support the crab bank operations. The result of the crab bank system activities has made the local fishers and other stakeholders aware of the importance of coastal and aquatic resources conservation and management.

Under the Japanese Crab Bank System, gravid crabs are marked on their carapace before these are released back to the sea for easy monitoring. An advisory is given to all fishermen in the area that whoever catches these gravid crabs are advised to release them alive back to the sea. If the fishers catch gravid crabs without numbers these should be deposited to the Crab Bank for marking after which these are also released to the sea.

Crab Bank System of ICRM-PD

The crab bank system of the Crab Bank Group in Pakklong, Pathew District was patterned after Thailand's Thung Maha Mangrove Conservation Network which aims to promote gravid mangrove crab conservation in the midst of decreasing mangrove crabs in many areas in Thailand (Thitiphorn, 2007). With technical support from the

Box 1. Japanese Crab Resources Conservation Scheme

- The scheme was developed by the Settsu-Harima Fishermen Cooperative in Hyogo Prefecture, Japan to enhance the dwindling crab resources in the Hyogo Prefecture. A voluntary organization known as the "Gazami Fuyasou Kai" (Swimming Crab Resource Enhancement Association or SCREA) was established in December 1986 in Hyogo Prefecture of Japan with the following justifications, approaches and activities:
- The main objective of SCREA is to enhance the crab resources by protecting the gravid crabs
- Under normal environmental conditions, a crab spawns 3-4 times a year (from May to September)
- A gravid female crab hatches about 1.8 million (between 1 to 3 million) zoea per spawning
- SCREA purchases gravid crabs from fishermen and paints them with red cross-marks on their carapaces and release them back to the sea
- When fishermen catch crabs with red cross-marks they should return the crabs back to the sea
- Female crabs usually molt after hatching a few times, making the red cross-marks disappear, these crabs could therefore be harvested
- Crabs with under 12 cm carapace length and with soft-shells should not be harvested and should be returned to the sea once caught
- Control season is limited for the spawning period of 5 months from May to September
- The expenses for purchasing the gravid crabs are shouldered by the SCREA funds contributed by its members
- Anyone can become a member of SCREA not necessarily those engaged in fisheries but also ordinary people
- Members of SCREA are provided with membership cards
- Annual contribution of each member is 1,000 Yen equivalent to 330 Baht

The major advantage of the SCREA Scheme lies in the high survival rate of gravid crabs and zoea.

Source: Etoh (2007)

Chumphon Marine Fisheries Research and Development Center (CMDEC), the crab bank system was initiated in 2002 by the Crab Bank Group of ICRM-PD. The Group established their own rules and regulations that include some conditions for membership and in order to become members of the Group, the fishers should have at least 300 crab traps per member per boat; should be a member of the fishers group (Pakklong Fishers Group or PFG); should bring at least one gravid crab per day or 30 gravid crabs per month; and the bottom of their crab traps should have a mesh size of 2.5 inches while the mesh size of the top and sides should be 1.25 in. The Crab Bank Group also organized a committee to screen the applicants for the Group. In addition, their regulations also provided that the crab traps should be used only in areas with 3 m water depth but they can use their traps throughout the year. Although some problems were encountered by Group that included conflicts with some members of the community in terms of gear use, but these have been solved through consultations and more particularly, zoning was established in the project site to address the issue.

From 2002 until 2007, the crab bank of ICRM-PD received a total of 19,475 gravid crabs, which have been regularly deposited in the crab bank (crab floating cages) with the necessary data regularly recorded. The crabs came from the crab trap fishers (members and non-members of the Crab Bank Group). Feeding of the crabs in the crab bank is done by members when they go fishing near the crab bank. After spawning, spent crab spawners are harvested and sold in local markets. The sale is divided into: 50% as common funds which the members of the Group can borrow with interest, 30% for cage maintenance, 10% for crab feeds, and 10% for operating expenses of the crab bank. The successful experience from this crab bank activity has been serving as a model for other coastal provinces in Thailand and even to other countries, as well as promoting a learning process for many students and researchers (Thitiphorn, 2008).

In order to assess the impact of the crab bank system on the crab resources in the ICRM-PD Project area, CMDEC conducted landing surveys on the CPUE of blue swimming crabs by the crab trap fishers. Results showed that the CPUE from 2002 to 2006 was 9.40, 9.45, 14.44, 17.13, and 12.96 kg/trip, respectively, while the average carapace length of male blue swimming crabs were 8.60, 9.17, 9.55, 10.15, and 10.39 cm, respectively. For the female blue swimming crabs, the average lengths were 8.97, 9.56, 10.01, 10.34, and 10.62, respectively (**Table 1**).

In an effort to further conserve the crab resources, the Chumphon Provincial Fisheries Office in August 2003, provided the fishers in its area with 100 traps (with enlarged mesh size of 2.5 in) per person in exchange for their old traps (having mesh size of 1.25 in). The CMDEC which has promoted the use of 2.5 in mesh size crab traps monitored the performance of the enlarged mesh size of the traps. The initial results showed increasing trend in terms of carapace size and volume of catch. When the mesh size used was 1.25 in, the average size of female caught was smaller than the

Table 1. CPUE and average size of blue swimming crabs caught by crab traps in Pakklong Sub-District, Pathew District, Chumphon Province, Thailand

Year	Catching Rate (kg/trip)	Average Carapace Length (cm)		Total Catch (mt/year)
		Male	Female	
2002	9.40	8.60	8.97	41.72
2003	9.45	9.17	9.56	44.34
2004	14.44	9.55	10.01	78.88
2005	17.13	10.15	10.34	98.33
2006	12.96	10.39	10.62	67.47

first mature size (9.74 cm) by more than 63% while that of the male crabs it was 17% smaller than first mature size (6.50 cm). When the enlarged mesh size was used, the average size of the female crabs was smaller than the first mature size by almost 52% while for the male crabs the average length dropped to about 4% (Jinda *et al*, 2004).

However, the crab bank method originally adopted by the Crab Bank Group of the ICRM-PD was not applicable during the southeast monsoon when big waves make it difficult for the Group to manage the crab bank. Thus, the Group having learned the Japanese method when their leader went on a study tour in Japan adopted the Japanese method of conserving crab resources by marking the carapace of the caught gravid crabs before these are released back to the sea.

Generally, through the crab bank method, a sense of ownership has been developed since the fishers themselves are managing the activity, giving the opportunity to improve their livelihoods and source of income. The Crab Bank System has also offered job opportunities to the other members of the community through post-harvest and processing, i.e. producing crab meat for sale. The initiative of the Group to implement mesh size control on crab traps was considered a means of mitigating the possible over-exploitation of the crab resources in the project site since the PFG considered it necessary to address the sustainability of the resources in order to enhance the livelihoods of the local people who are dependent on such resources.

Crab Bank Scheme of Bang Saphan Bay Pilot Project

The Bang Saphan Bay Pilot Project (BSBPP) in Bang Saphan Bay, Prachuab Khiri Khan Province in Thailand has been promoting the community-based coastal fishery resources management project for more than 10 years through the initiative of the Department of Fisheries (DOF) of Thailand. Following the successful experience of the Crab Bank Group of ICRM-PD, BSBPP also introduced the Crab Bank System in 2005 following the ICRM-PD model, by constructing cages for stocking gravid crabs. After few attempts however, the system was discontinued due to problems such as daily feeding, maintenance of cages, etc. and unfavorable sea conditions considering that the coastline of Bang Saphan is very much exposed to the open sea (Etoh, 2007). Confronted by such circumstance, BSBPP adopted the batch system using hatching tanks where gravid crabs in the last stage of spawning (with black colored eggs) are kept in plastic tanks (100 liters) until the eggs are hatched after which the zoea are released to the sea. The spent crab spawners are sold by the fishermen who caught the crabs.

Blue Swimming Crab Conservation (Crab Condominium) Project in Chonburi Province, Thailand

The blue swimming crab (*Portunus pelagicus*) is a commercially important aquatic species in Thailand particularly in Chonburi Province. However, the yield of this species has drastically decreased due to over harvesting. In addition to being severely exploited, the stock has suffered from habitat degradation and non-selectivity of fishing gears, which tend to remove most of the size classes from the population. Chonburi Province plays a key role in the tourism industry of Thailand, as it is where the most popular Pattaya City is located and where among the attractions is the fresh and tasty sea food including the blue swimming crabs. A papaya salad known as "Som-Tam" for example, which is prepared using young crabs is a popular delicacy. Crabs are also supplied to local and international markets. Significant decrease in crab population has already affected the supply of crabs to local and foreign markets, and increased the price considerably, and has significantly affected the local livelihood and income of fishers. Concerned stakeholders therefore took action to ensure the sustainable utilization of Chonburi's crab resources, applying innovative technology together with local knowledge. Thus, the Crab Bank System of ICRM-PD was introduced with some innovations in the coastal areas of Chonburi to promote sustainable crab fishery and protect the spawners from being over-exploited. Adopting the concept of local-based fishery management, crab spawners caught from fishing grounds are placed in submerged resting cages (called Crab Condominium or Crab Condo) until the eggs are released (each spawner could release 700,000 to 1.4 million fertilized eggs), after which they are either sold to consumers or released back to the sea.

Crab Condo has been successfully established by the Rimtalae and Srirachanakorn communities in Sriracha Municipality in 2006 as part of the initial implementation of the Chonburi Coastal Strategy. Later the system was also adopted in nearby Bangsarae and Bangohra Municipalities. This project involves the establishment of convenient floating containers with submerged resting cages where gravid crabs collected from fishermen are placed in separate baskets which are vertically stacked like condominium. Responsible teams consisting of fishers and members of communities' committees are assigned to maintain the cages and feed the gravid crabs, and to return them back to the owners or marketing after the crabs have released the zoea as well as to educate and provide advice to other interested stakeholders supported by municipal officers.

Evaluation of the impact of the project in Sriracha Bay in terms of increased blue swimming crab population is being

Crab Condo installed in Sriracha Bay

done through regular environmental monitoring by relevant research institutes and the public, such as the Chonburi Fishery Association, local academe and a consultant from the Integrated Coastal Management (ICM) project who has been providing the technical advice. Information dissemination and capacity building for project members are conducted through training, study tours to existing crab condos, and exchange forums. In collaboration with the Sriracha Fisheries Research Station of Kasetsart University, sea water quality monitoring is regularly undertaken to assess and evaluate potential impacts of the activity on the quality of water in Sriracha Bay.

An assessment of sea crab yield was also undertaken to evaluate the impact of the project on the blue swimming crab population. However, there were no scientific surveys conducted before in the project area that can serve as baseline for assessment. Thus, information from fishers in three municipalities has been considered valuable information in the assessment of the crab stocks. The fishers have reported an increase in crab catch in 2007 compared with that of 2006. In Bangohra Municipality for example, one of the big fishing ports in Chonburi Province with specific market for crabs, crab catch was around 40 kg/boat/day in April 2006, while catch in April 2007 was around 100 kg/boat/day (the same as the catch in the peak month in November 2006). Considering the high cost of scientific study/assessment, an evaluation of the Crab Condo project of Sriracha Municipality was done through a systematic survey of the changes in crab catch in the project area through questionnaires.

The Crab Condo project has promoted awareness and recognition of responsible fishing and resource conservation. It has also enhanced eco-tourism in Koh Loy Public Park near the Sriracha Bay by including crab releasing activities in the Crab Condo among the various attractions. The Crab Condo project has also effectively transferred the knowledge to the youths through experiential learning and information dissemination, and the best practice on Generosity Approach among community teams considering that the Crab Condo Project is managed by the members of the fishers group of the Municipality who serve in the project voluntarily and without extra compensation.

Crab Bank System of ICRM-PL

Two main common species of swimming crabs (blue and red) are found in Malaysian waters having high demand at all levels of the fish market chain. Results of a survey conducted in the ICRM-PL project site in Pulau Langkawi, Malaysia showed that about 3,500 kg of swimming crabs are landed predominately by gill netters. The crab resources became a candidate for resource conservation in order to avoid over-exploitation. During the study tour of the KEN (Kumpulan Economi Nelayan or Fishermen's Economic Group) members to the ICRM-PD Project site in Thailand, their interest on the crab bank system was mooted. Specifically, the serious commitment of the local fishers from Pathew District on the conservation of the crab resources served as an inspiration for the KEN members and boosted their decision to carry out a similar scheme in the ICRM-PL Project site. Steps were therefore initiated by KEN in Kuala Teriang to obtain a suitable site from the Langkawi Development Authority (LADA) to introduce the crab cage system.

Having been unsuccessful in obtaining a site for the crab bank, KEN initiated the Japanese model of crab bank system, which was also successfully introduced in the ICRM-PD Project in Chumphon, Thailand. Considering that this model does not require any cages, it could be cost effective. However, this system requires the voluntary commitment by the members specifically in releasing the gravid crabs caught back to the sea after marking the carapace (Krishnasamy, 2008).

A workshop on Crab Bank System for the crab fishers was therefore organized to disseminate the concept, procedures, methodologies and recording in logbooks as well as the appropriate way to release the crabs back to the sea. The Crab Bank Sub-group was also organized and a signboard to promote the activities was made.

The Crab Bank System introduced to the fishers in Kuala Teriang, Langkawi (i.e. the crab trap and gill net fishers) aims to: (1) make the crab fishers (stakeholders) aware of the voluntary scheme of releasing gravid crabs caught alive back to the sea after marking the carapace; (2) preserve and sustain the crab resources as well as minimize their extinction by taking necessary steps on resource utilization at an optimum level; (3) encourage and impart awareness to the fishing communities and the public on the steps to conserve, protect and rehabilitate the crab resources; (4)

promote teamwork, cooperation and responsibilities towards the importance of crab resources conservation within the fishing industry; and (5) promote the KPSP as the front-liner and initiator of the management and conservation of crab resources to the fishing communities and industries.

After the workshop, the Crab Bank Sub-group agreed to abide by the conditions on recording the number of every gravid crab caught in a logbook provided to each member, and follow up and counterchecking efforts by the District Fisheries Extension Officer. Meanwhile, KEN was restructured into the Fishery Resources Management Community or KPSP (Komuniti Pengurusan Sumber Perikanan) to take full charge of the community-based fisheries resources management (CBRM) functions specifically in strengthening the livelihoods of the fishing communities.

Thus, the crab trap and gill net fishers of the KPSP Kuala Teriang became the participating members of the Crab bank Sub-Group. However, when the logbooks were inspected in December 2007 only three (3) participants provided the necessary data, many did not record for some reasons such as loss of their log books although according to some members, they released gravid crabs but never recorded. Nevertheless, after the introduction of the system, the fishers have reported that the crab landings have since then increased slightly and the system appeared to be more practical, applicable and acceptable for implementation.

It was understood that the participation of the members was not active and they seemed not willing to use traps because the gears either drifted or were stolen. A new group consisting of 10 members using traps and gill-nets volunteered to take part in the project. Thus, the Department of Fisheries (DOF) Malaysia agreed to continue promoting the program under its ongoing fisheries extension activities through dialogues, study tours, short-term training sessions, and onsite demonstrations with the fishing communities especially the crab fishers.

The DOF also agreed to conduct monitoring, collection and analysis of the catch data with the collaboration of the Fisheries Research Institutes throughout the country. DOF has also made initiatives to produce leaflets and pamphlets on crab bank system to promote the system and conducted a number of awareness programs for the stakeholders and the public on the conservation of the crab resources.

The crab bank activities have been evaluated from time to time in accordance to the needs and the convenience of the stakeholders and the responsible authorities, to make the crab bank approach acceptable and its implementation successful. The DOF is also identifying other suitable

Gravid crab caught by gill net near the ICRM-PL Project site (right); and Marked gravid crab to be released to the sea (below)

KPSP groups or individuals especially the crab fishers to introduce the Crab Bank System in their areas as part of their conservation effort.

Rewards and appreciation to the crab fishers in the form of certificates and prizes have been given by the DOF as form of encouragement to the crab fishers. The adoption of the Crab Bank System could also serve as a platform for the involvement of dignitaries and corporate bodies at the local level, which ultimately would benefit the local fisheries communities. The DOF recognized that along with the experience from Thailand and Japan, the implementation of a Crab Bank System which is simple and cost effective, could contribute to the conservation and protection of the dwindling crab resources. It could also create awareness and responsibility among the fishers in contributing to the enhancement of the resources, through voluntarily participation by the stakeholders for the benefit of the fishing industry.

Crab Bank System of ICRM-SV

For the establishment of a crab bank system at the ICRM-SV Project site in Sihanoukville, Cambodia, a consultation with concerned stakeholders was held where three possible crab bank approaches were discussed: the Japanese model, Chumphon model and Langkawi model. It was then decided to employ the Chumphon model, which involves the stocking of gravid crab in a cage during the calm seasons until the eggs are hatched, while during the monsoon seasons gravid

crabs are released directly into the sea after being marked on their carapace. The Crab Bank Group was established and responsibilities and roles were also developed. The position of the cages for hatching gravid crab was also sited.

Showing keen interest in the implementation of the Crab Bank System in Cambodia, its Fisheries Administration (FiA) introduced the system along the coast line in Cambodia, i.e. in Stung Hao and Pery Nup. The Stung Hao Crab Bank was initiated in March 2008 based on the model in Chumphon, Thailand. The cages were installed at the top of a jetty which makes easy access for feeding and stocking.

The members of the Crab Bank Group of ICRM-SV constructed the cages and initiated the stocking of gravid crabs in May 2008 with 10 crabs released in a cage and 8 crabs were sold after hatching in June 2008. The number of gravid crabs collected was relatively small, and as reported by the crab banks in Stung Hao and Pery Nup, the total number of gravid crabs collected in May and June has noticeably reduced (Chanthana, 2008).

It was suspected that the small number of gravid crabs collected was due to the number of bank cages installed in Prey Sangke where crab gill net fishing is predominant and where majority of the members of the Crab Bank Group come from. The survival rate of gravid crabs caught in the gill-net is extremely low compared with those caught by crab traps. Since most of the members are engaged in crab gill-net fishing, the FiA has encouraged more crab trap fishermen to join the crab bank systems implemented in the coastal areas of Cambodia.

Way Forward

The blue swimming crab (*Portunus pelagicus*) is economically important not only in Thailand, Malaysia and Cambodia but also in the other countries in Southeast Asia. The considerably high demand of the crabs in the market (local and foreign) has driven many fishers to catch crabs by any means without considering sustainability. This has led to over-exploitation of the blue swimming crab resources in many areas in the Southeast Asian region. Considering that many fishers depend on this resource for their livelihoods, it has become necessary to conserve such

Table 2. Comparison of three crab bank systems

Assessment/System	ICRM system (Chumphon)	Batch system (BSBPP)	SCREA system (Japan)
Survival rate of gravid crabs	Low (about 50%)	High as stocked only in few days	High (in the natural environment)
Survival rate of zoea	High (in the natural environment)	Relatively low (in aerated tanks)	High (in the natural environment)
Target gravid crabs	All gravid crabs	Only matured crabs before hatching	All gravid and potentially gravid crabs (marked)
Operational season	During the calm seas season	All seasons	Spawning seasons
Cost of investment and operation			
• Initial investment	High (cages, etc.)	High (shed, plastic tanks, aerators, etc.)	NIL
• Labor	High (daily maintenance at sea)	Medium (daily maintenance on land)	Marginal (only marking)
• Feeds	High (one month at maximum)	Negligible (a few days at maximum)	NIL
• Fuel	High (daily maintenance at sea)	Negligible (combined with fishing)	Negligible (may rely on fishing trips)
• Maintenance	High (repair of cages)	Negligible (repair of aerators, etc.)	NIL
Income for Fisher Members	NIL (although indirectly there is in from of loans)	Sale of spent spawner crabs after hatching	Sale of gravid crabs
Institutional Support	Marginal	Needed to some extent	Need to some extent (e.g. promotional activities)
Organization	Needs strong leadership and coordinator	Needs strong leadership and coordinator	Need strong public awareness
Fund raising	Not necessary	Not necessary	Rely on fishermen as well as public contributions
Sustainability	Subject to leadership	Subject to leadership	Subject to public awareness
Visibility of impacts	High	High	Low

Source: *Etoh (2007)*

resources and through the Crab Bank System initiated by concerned fishers groups as exemplified in the crab bank activities of the ICRM-PD Project (Thailand), ICRM-PL Project (Malaysia) and ICRM-SV Project (Cambodia).

The Crab Bank System promoted through the SEAFDEC ICRM project has enhanced the awareness of fishers on the need to manage the resources to improve their livelihoods. It has also made the stakeholders aware of the importance of coastal and aquatic resources conservation and management. Since management of the crab bank system has been carried out by the fishers themselves, it has created a sense of ownership and therefore promoted sustainability. Through intensive promotion, the experience from the system could be effectively transferred to the youths specifically the students through experimental learning and information dissemination during conducted study tours.

The other countries in the region could therefore adapt the system or scheme already developed by the ICRM projects or the Japanese scheme. Etoh (2007) has made a comparison of three systems (Table 2) which could serve as basis for any country in their efforts to promote the Crab Bank System for the protection and conservation of their respective crab resources as well as enhancement of the livelihoods of the poor fishers and increasing their incomes, thus ultimately achieving poverty alleviation and food security in the fisheries communities.

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Enhancing Fisheries Management for Poverty Alleviation and Resources Conservation: The Community Fisheries of Cambodia

Suy Serywath and Leng Sy Vann

Cambodia is situated in Indochina Peninsula of Southeast Asia with a total area of 181,035 km^2 and water area of 4,869.84 km^2 with about 30% of its land area seasonally flooded, which is a very important factor for inland capture fisheries. Lying between 10^o-15^o N latitude and 102^o-108^o E longitude, Cambodia is bounded on the southeast by Vietnam, on the north by Lao PDR and on the northwest by Thailand (**Fig. 1**). The country's EEZ extending from the shoreline to 200 nautical miles is 55,600 km^2 and its coastline stretches about 435 km in the Gulf of Thailand, where four provinces/cities are located, namely: Kep Municipality (26 km), Kampot Province (67 km), Sihanouk Ville (105 km), and Koh Kong Province (237 km).

Fig. 1. Map of Cambodia showing the four coastal areas: Kep, Kampot, Sihanoukville, and Koh Kong

The country has a tropical monsoon climate with two distinct seasons: dry season (November to April) and wet season (May to September or October). The country's total population in 2008 was recorded at 14,241,640. The fisheries sector in Cambodia constitutes an integral part of rural livelihood and a major contributor to the national economy and food security. Fish provides more than 75% of the total animal protein intake in the people's diet. The freshwater and marine fisheries sub-sectors provide employment to over 2 million people, many of whom are living in the poor rural areas. Of the country's total production from capture fisheries of 482,500 mt in 2006 (FAO Fishstat Plus 2008), 422,000 mt (88%) came from inland capture fisheries, while only 60,500 mt was contributed by marine capture fisheries. The country's aquaculture production in 2006 was 50,200 mt (FAO Fishstat Plus 2008).

Box 1. Inland Fisheries Management Systems in Cambodia (1950-present)
1950-1975: Fishing lot system
During this period, the fisheries resource was managed and controlled by the Department of Fisheries (DOF[1]). The fishing lot system, developed by French experts put into practice since 1940, was applied through a bidding process.
1975-1979: No fisheries management system
Although there was no individual and large scale extraction of the fisheries resource, partial fishing for the Khmer Rouge elites was carried out. The Khmer Rouge regime focused only on rice production while the fisheries resource was left to flourish.
1979-1982: Public-fishing areas
The Pol Pot regime had just ended its rule in the country and the people could fish freely in all fishing domains (public fishing areas). Fisheries management in the country had not yet been organized and the DOF was not yet established. The abundance of fish was remarkably noticed. However, dynamite fishing was commonly practiced by soldiers and citizens.
1982-1989: Solidarity group
The DOF was organized and fisheries resource and exploitation were managed through a solidarity group in Khmer called the "Krom Samaki", practicing a form of a state own-enterprise. The Krom Samaki fished collectively in commercial scale and shared the benefits equally with its members. The main objectives of Krom Samaki were to protect the village area from intrusion by the Khmer Rouge forces and to purchase fish products (mainly dried and smoked fish) to supply the food requirements of the soldiers at the frontier.
1989-1998: Fishing auction
During this period, the fisheries law had been promulgated based on the fisheries law of 1950 which has been modified and upgraded. The fishing activities were divided into three categories, namely: large-scale fishing (fishing lot and Dai fishing), medium-scale fishing, and small-scale fishing (subsistence fishing or family-scale fishing).
1998-2000: Fishing lot with total sub-leasing and research fishing lot
During this period, most of fishing lot owners after successful bidding, divided and leased their fishing lot areas to different fishing operators. Although this was illegal according to the fisheries law, enforcement was not exercised. In 1998-2000 research fishing was also introduced but rather as an excuse for taking commissions, while conflicts and disputes arose between the fishing lot owners and fishermen. Due to the increasing population of fishermen, encroachment of the public fishing areas and indiscriminate control by fishing lot owners had also increased dramatically. Thus, the policy reform of fisheries was carried out starting in October 2000.
2000-Present: Reform of the fisheries management system
The Royal Government of Cambodia through the DOF released the fishing lots and gave these to adjacent communities for them to manage, where the local people are expected to use and manage the resources in sustainable manner.

Remarks:
[1] DOF until June 2006, henceforth DOF was changed to Fisheries Administration (FiA)

Cambodia has a wide freshwater ecosystem from the Mekong River, which is about 500 km long with water that flows into four main tributaries, namely: the Great Lake, the Tonle Sap River, the Lower Cambodian Mekong River, and the Bassac River (APIP, 2001). The Great Lake, located in the center of the country and the Tonle Sap River drain to the western part of the country. As a natural flood reservoir of the Mekong River, the Great Lake supports the country's major inland capture fisheries. In the flood season the lake has a water area of 10,000 km^2 and water depth about 10-14 m, and during the dry season it reduces to an area of about 3,000 km^2 with an average depth of less than one meter. During the monsoon, the Great Lake expands to more than 6,000 km^2 area inside the inundated forest creating an enormous and effective breeding, spawning, nursing and feeding grounds of various aquatic species. Almost 60% of the country's freshwater fishes are produced in the Tonle Sap Great Lake.

The Inland Fisheries Management System of Cambodia

The country's inland fisheries resource management has been influenced and determined by the different political and management regimes of Cambodia. Each management system (**Box 1**) has had both good and negative implications on the fisheries livelihood and the status of the aquatic resources, with the fisheries resource having been managed and exploited following different arrangements from the past to present (Tonle Sap Environmental Management Project, 2003).

Box 2. Main elements of the enhanced fisheries management of Cambodia
• Creation of job opportunities and upgrading the livelihoods of people in local communities
• Ensuring equitable access to and distribution of fisheries benefits including export earnings
• Extending institutional responsibilities of fisheries management to community fisheries
• Protection and sustainable use of fishery resources
• Promotion of aquaculture to fulfill the nutritional requirements of the people in order to reduce the catch of wild aquatic resources
• Promotion of integrative fisheries management with overall rural development in community fisheries
• Conservation, management and development of fisheries resources for sustainability through cooperation with local authorities and community fisheries such as in fishing areas, fish habitats, inundated forest, etc.

Box 3. Fisheries management strategies of Cambodia

- Establishing and maintaining the institutional and administrative framework, which is necessary to make community-based fisheries management a feasible and effective alternative to the existing management systems. Activities in these strategic areas include the introduction of the new law, necessary sub-laws, new administrative systems and procedures for DOF to effectively support local communities.
- Conduct of research, assessment and evaluation activities to provide information to support the operation and management of the local fisheries councils. As the custodian of Cambodia' living aquatic resources, the DOF is responsible for establishing and maintaining the national fisheries policy framework and ensuring that fisheries activities at the local level are carried out in conformity with sound biological and ecological principles.
- Training local fisheries councils and communities to effectively execute their administrative and managerial responsibilities. DOF has worked closely with various learning institutions and promoted the use of modern technologies to ensure that local fisheries communities can access to and participate in learning and skills enhancement activities in order to broaden their capacity to effectively manage and administer the local fisheries.
- Exchanging of fisheries related information with local fisheries councils, local administrations and the general public. As an integrated part of its operations, DOF ensures the timely and effective sharing of all information related to management and administration of Cambodia's fisheries and fisheries in general.

Policy Reforms in Fisheries Management

In November 2000, the Royal Government of Cambodia started to undertake fishery policy reform as part of the country's poverty reduction strategy. The key elements of the reform included: the reduction of 53 concession fishing lots with a total area of 536,302 ha or about 56% of the total fishing lots area for small-scale fishing, promotion of community fisheries establishment in areas where some parts or whole parts of fishing lots were released, abolishing license fees for medium-scale fishing in inland fisheries, and reducing the license fees for some selected coastal fishing gears.

The Government also introduced a new fisheries management system, which empowered the local people to manage and use the fisheries resource. Some of the fishing lots were released for the communities adjacent to the fishing grounds to be managed by them. Community fisheries were promoted with the aim of protecting the sustainable fishery resources and providing fishing rights to local people in order to improve their living conditions. In this connection, the Ministry of Agriculture, Forestry and Fisheries (MAFF) established the Community Fisheries Development Office (CFDO) under the Fisheries Administration (FiA), specifically tasked with supporting communities to manage the newly released fishing areas and encouraging more participatory management of fisheries country-wide. In particular, the CFDO was established to provide technical assistance particularly on socio-economic and community development issues. The main elements of the reformed management system for the fisheries resources are shown in **Box 2**.

Fisheries Management Strategies

The DOF paid strong attention to community fishery

Box 4. The inland fishing grounds of Cambodia (Fisheries Law, 2006)

- **Fishing Lot Areas:** Reserved for investments in large-scale fishing operations
- **Fish Sanctuary Areas:** Habitat of inland aquatic animals and plants
- **Open Access Area:** Reserved for small-scale fishing operations
- **Inundated Forest Area:** Habitat for spawning of aquatic species and feeding habitat
- **Floodplain Area during Rising Water:** Habitat for spawning and feeding of aquatic species and fishing ground for small-scale fishing operations

Box 5. The marine fishing grounds of Cambodia (Fisheries Law, 2006)

- **Coastal Area:** For small-scale and medium-scale fishing operations, and extends from shoreline up to less than 20 m water depth also called "Fishing Zone One"
- **Offshore Area:** For commercial-scale fishing operations, and extends from 20 m depth up to the EEZ also called "Fishing Zone Two"
- **Sanctuary Area:** Consists of coral reef areas and sea grass beds reserved for habitats of marine aquatic animals and plants
- **Mangroves Protected Area:** Mangrove and forest areas which are covered with tidal waters and important feeding, spawning and breeding habitats for marine aquatic animals and inundated protected area

Box 6. Fisheries domain

Domain assigned by group

- Fishing areas defined as fishing lots, fishing barrages, and bag net fishing (or Dai fisheries) reserved as resources monopoly for a person or enterprise for large-scale fishing operations
- Flooded forest areas including all forest ranges flooded during monsoon, and are necessary shelters of aquatic species feeding and spawning
- Fish sanctuaries reserved for fish species reproduction or for conducting experimental works on techniques and scientific research of fisheries within which all fishing is prohibited

Fisheries protected domain

- All other areas not mentioned in any criteria of the fishing domain assigned by group, for which the general rules apply and where fishing is allowed for both small-scale and medium-scale operations

Table 1. Range of annual production from freshwater capture fisheries of Cambodia (1994 -2000)

Source of Catch	Annual catch range (mt)	Percentage (%)
Large-Scale Fisheries		18
• Fishing Lots	25,000-75,000	
• Dai Fisheries	14,000-16,0000	
Middle-Scale Fisheries	85,000-100,000	26
Small-Scale Fisheries	115,000-40,000	56
Rice Field Fisheries	50,000-100,000	
Total Catch	289,000-431,000	100

Source: *Van Zaling et al. (2000)*

management specifically in managing and using the fisheries resources in sustainable manner. The strategies of DOF (**Box 3**) focused on carrying out a broad range of consolidated activities aimed at providing effective and timely support to the smooth introduction of community fisheries management as provided for in the Master Plan for Fisheries 2001-2011 (APIP, 2001a).

Fisheries Domain

The fisheries sector of Cambodia includes the inland and marine fisheries sub-sectors. Inland fishing is done in floodplain areas, fishing lots, and in rice fields (**Box 4**) while marine fishing is operated in the fishing zone from the coast up to less than 20 m depth waters (**Box 5**). The country's fisheries domain is divided into two types based on the set of regulations applied. These are the fisheries domain assigned by group and the protected fisheries domain (**Box 6**).

Inland Fisheries Sub-sector

Fishing operations in inland fisheries include small-scale, medium-scale and large-scale. Small-scale fishing operation is done whole year round, and is also a form of family/household fishing for family consumption/livelihood and using traditional fishing gear. Medium-scale fishing requires license through a fixed license per gear and can be operated only during the fishing season from 1st October to June 30th of succeeding year. The cost of license is fixed based on an estimate of the expected gear type such as gill net longer than 10 m, seine net, fishing trap associated (Lop Nor or Rav) not longer that 500 m of bamboo fence, etc.

One main type of medium-scale fishing is called "dai fisheries", using a bag net or stationary trawl positioned in the river to capture fishes migrating downstream (Van Zalinge *et al*, 2000). Large-scale fishing consists of fishing lot operations, barrage fishing and bag net fishing (dai) which are larger than the "dai" in medium-scale, and licensed through an auction system for a period of two years lease term. The system provides monopoly of resource utilization within a given area or at a defined site in the lake or river to a private individual fisherman/company with some restrictions on the operation such as closed season before which all fixed installations must be dismantled. The catch from the fishing lots, if too large may be reserved for subsistence fishing. The "fishing lot" (loh nessaat) is a concession auctioned by the government to the highest bidder for exclusive exploitation over a two-year period. This was one of the main instruments used by the government to generate revenues from the rental of the fisheries resources (Van Zalinge *et al*, 2001). Inland fisheries contribute more than 70% of total capture of the country's annual production from capture fisheries. The annual inland production from capture fisheries are ranged from 300,000-400,000 mt/year with small-scale fisheries contributing about 56% (**Table 1**).

Marine Fisheries Sub-sector

Marine fishing operations of the country also comprised the small-scale, medium-scale and large-scale. Small-scale or artisanal fisheries, characterized by open access fishing, operate in fishing zone which extends from the coast to a

Box 7. Events related to fisheries domain assigned by groups

- **1994:** A community fisheries was established in Svay Rieng Province specifically for a community fish refuge management in areas where there was no fisheries domain in cooperation with the Asian Institute of Technology (AIT). The main objective was to promote the participation of the local people to conserve the fish refuge during dry season.
- **1995:** A community management of flood forest was established in Siem Reap Province with the objective of promoting sustainable management of the natural resources within the Tonle Sap Great Lake through local community participation. This activity was implemented by the Provincial Department of Agriculture (PDoA) and the Provincial Office of Fisheries with support from the Food and Agriculture Organization (FAO) of the United Nations.
- **1997:** Deep pool co-management was set up in Kratie and Stung Treng Provinces supported by the Community Aid Abroad (CAA) organization and the country's Culture and Environment Preservation Association (CEPA). These organizations have supported the development of community fisheries regulations by each village with technical support provided by the Provincial Fisheries Office (PFO).
- **1999:** Reservoir co-management project was started in Kandal and Kampong Cham Provinces supported by the Mekong River Commission (MRC/MRRF). In mid 1999, community co-management of fisheries was established in Ream National Park of Sihanouk Ville supported by the Wetlands International Organization. This project was implemented by the Ministry of Environment (MoE).
- **2000:** The Royal Government of Cambodia, through the DOF/FiA reformed the fisheries policy of the whole country by empowering the local communities to manage the resources by themselves known as the "community fisheries" or CF.
- **2006:** 509 community fisheries (CFs) have been developed: 469 are inland community fisheries and the rest are coastal community fisheries. Of these, 309 CFs have their own regulations, 197 CFs have mapping systems, 58 CFs have agreements, 65 CFs have management plans, 142 CF have action plans, and 95 CFs have established fish sanctuary areas.

depth of 20 m. It is a year round fishing activity by family/household with fish production directly consumed by the fishing family, with the surplus or high quality fish sold for additional income of the fishing family. Boats used are without engines or with engine of less than 33 Hp, which do not require any license. Fishing activities such as trawling, light fishing and using illegal fishing gear not listed in the fishery law are not allowed.

Medium-scale fisheries make use of relatively efficient fishing gear having the capacity to fish offshore. Boats used are with engine more that 33 Hp but less than 50 Hp. The fishermen using this scale are required to pay a fishing fee to the government according the fishery law. Commercial fishery on the other hand, is characterized by large-scale fishing operations from 20 m depth to the limit of the country's EEZ. The boats used are with engines more than 50 Hp, and required to pay a fee following the fishery law. Different kinds of fishing gears are used including single trawling. Fishing gear and fishing method such as pair trawling, light fishing and other fishing gears not listed in the fishery law are prohibited.

Establishment of Community Fisheries

Community fisheries (CF) management in Cambodia has been initiated but the process of CF establishment and implementation varies depending upon the guidelines set by the supporting organizations and government agencies (**Box 7**).

Implementation of Community Fisheries Management

Community fisheries management was initiated in Stung Treng Province in 1997 (Gum, 2000). The (CAA) has supported the development of community fisheries regulations by each village with technical support provided by the PFO. The regulations focus on reducing illegal fishing such as the use of explosives and electric fishing, minimizing the clearing of inundated forests and protection of selected species. These regulations have been recognized by the PDoA and the PFO, and the project has demonstrated a promising model for cooperation between community fisheries and local authorities facilitated by NGOs but requires strong institutional support from the DOF and MAFF. The experience in community fisheries management used in Siem Reap Province which was developed by the Participatory Natural Resource Management under the Tonle Sap Region Project (**Box 8**) has been used as model throughout the country (Somony, 2002).

Issues and Concerns in Community Fisheries Management

The country's declining natural fish stocks including species composition is well recognized. About 300 to 500 fish species have already disappeared from the Tone Sap Great Lake (Mak, 2000). Excess fishing effort and the associated decline in abundance of target species are serious problems confronting the fisheries of Cambodia. The key causes appear to be the increasing population coupled with an economy that is not expanding rapidly enough to cater to the rising needs, and the policy of the Government allowing everyone to fish for subsistence or income.

Box 8. Processes in community fisheries development and management

- **Contact with local authorities** (Letters of authorization from the province delivered to the district governor by the facilitation team, where objectives and work involved were explained. The District Governor and other authorities (military/police) are kept informed and are involved in the process)
- **Identification of users** (Primary and secondary users are identified through local authorities, village chief and local fishermen, while discussions are held to ensure accuracy of information)
- **Participatory resources assessment** (For each site, a PRA is conducted with all the primary and secondary users regarding resources use, supply and demand conflict, etc.)
- Village meeting (in each village to discuss PRA result and review sketch map, identify the resources area that individual village use and want to manage, elect village representatives to a village level community fishery committee, and identify the objectives of the resources management and to draft the rules and regulations)
- **Central workshop** (with village committee members, commune and provincial authorities to elect a central management committee with representatives from each village, clearly defining the resources boundary, and identify those responsible for the protection activities and extension work)
- **Demarcation and mapping** (community fishery resources are defined and mapped using GPS, demarcation is carried out)
- **Rules and regulations** (finalized for each community fishery site by their central committees and made public with corresponding map to inform all potential users as to the location and users obligation for the given resources. These are endorsed and signed by the central committee, the district governor, the provincial director of fisheries, and by the provincial director of MAFF)
- **Management plan** (central management committee in consultation with village committee and fishermen draft a 5-year operation plan defining the activities and actions related to resources protection, management and enhancement, as well as distribution of benefits

Way Forward

Inland and marine fisheries are the main contributors for the country's livelihood needs and food security. Fish is an important source of nutrients for Cambodians and fisheries provide income generation for both the government through taxation of fishing operations and the households through fishing. However, the fisheries resources suffer from both unsustainable management and over exploitation. Even through there are no scientific evidence on the declining natural fish resources of Cambodia, its production trend suggested that the resources are suffering from both human activities and natural disasters.

Co-decentralization through open access for fisheries management based on community fisheries is on the way out while small-scale community fisheries management is already in place. In order to address the issues and concerns, the country through the FiA is exerting efforts to sustain a number of activities, that include the following:

a. Boundary demarcation between fishing lots and fishing areas of community fisheries (not yet been completely marked)
b. Prevention and cracking down on illegal fishing gears (e.g. use of electrocuting equipment, fine-mesh nets (mosquito nets), push netting, etc.)
c. Minimizing controversial issues among stakeholders on the CFs (still no clear legal framework regarding sub-decree on community fisheries, sample by-laws and other provisions for Community Fisheries Management)
d. Increasing awareness and understanding on community fisheries by community fisheries officers and local authorities
e. Minimizing controversies between community fisheries and CF regulations (CF asking for the right to crack down and fine illegal fishing activities, and specifically for the right to do commercial fishing in their community fishing areas contradictory to the Sub-decree on removal and release of fishing lots for family-scale fishing)
f. Encouraging the local authorities (Commune Councils and Sangkats) to fully support the CF activities (in some cases community fishing areas are sold to businessmen in the name of the CF)
g. Alleviating poverty among fishers (poverty being an obstacle for the organization and management of community fisheries)
h. Sourcing of funds for necessary materials, budgets and other means for dissemination and extension, organization, strengthening, monitoring and evaluation of community fisheries
i. Finding solutions on why community fisheries organized by the Provincial and National Fisheries Department seem not to function (due to budget constraints and technical limitations?) while most community fisheries supported by NGOs and IOs in cooperation with fisheries technical provincial and national departments are functioning well.

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Shifting Fisheries Structure towards Sustainable Development: A Case Study in Vietnam

Duong Tri Thao

This paper aims to review the real situation of the national fisheries structure of Vietnam in the transitional period over the previous years, and especially considering the present time. The characteristics and fundamental factors that made significant impacts on the restructuring process have been considered as these could provide practical basis for prescribing orientations and recommendations for a healthy restructuring in the years to come.

For many years, the fisheries sector in Vietnam has greatly contributed to the creation of new jobs for millions of people. However, many inhabitants of the communities in the rural and coastal areas continue to be within the low level socio-economic conditions, relying heavily on agriculture and fisheries for their livelihoods. The prospects of expanding fishing operations and maximizing the use of the natural resources such as the fish stocks, soil and water could be a way out for these communities, but much pressure could be put on the resources desired and could lead to some socio-economic effects which in turn could entail a vigorous sectoral pattern. Nonetheless, shifting towards enhancing livelihood activities, optimizing resource utilization, advancing socio-economic effects, improving the quality of lives, and protecting and conserving the environment, all combined have been considered as possible strategies that could ensure sustainable development of the country's fisheries sector and alleviate poverty in the fisheries communities.

Restructuring of the country's fisheries done in the past and also during the most recent times with the goals of achieving sustainable fisheries development, should be reviewed in order to thoroughly understand the real situation of the fisheries in Vietnam specifically its structure which has been shifted through the years. The characteristics and fundamental factors that have made significant impacts on the process should also be defined to create the practical basis for prescribing orientations and recommendations. This would also be crucial and useful for further restructuring in the years to come. The facts and figures collected during the case study, seem to suggest that in many aspects, the fisheries pattern in Vietnam has been changing towards the right and proper direction. This has been demonstrated in terms of the enhanced fish stocks, the positive economic effects created and the society's demands having been fulfilled. However, the expected transition has been happening very slowly thus, sustainable development could not yet be ensured.

In order to attain the socio-economical goals adopted by the government, the whole system of fisheries production must be shifted from being natural resource intensive based to be technology intensive. Following the National Master Plan for Fisheries Development of Vietnam, the fisheries has been encouraged to address the pre-requisites and conditions for sustainable development in order that fisheries development could thrive on the knowledge pool by the year 2020 when intellectual human resources would then be primarily relied on.

Current Status of Fisheries Restructuring in Vietnam

The impact of the fisheries restructuring in Vietnam is better described in the three major sub-sectors, namely: marine capture fisheries, aquaculture and fish processing.

Marine Capture Fisheries

Along with the overall development of the nation at large and the fisheries sector in particular, the capture fisheries structure of Vietnam especially the marine capture sub-sector, has been observed to be progressing well. Although the process to some extent is characterized by spontaneity, the progress appears to be going upward and ready for further development. Due to technological progress, the country's fishing vessels have been transformed and improved while the fishing gears are gradually upgraded. Production and catch composition targets have been refocused to respond to the changes in market demands. Fishing grounds have been expanded beyond the traditional areas to include underexploited waters. The traditional characteristics of the fisheries have been reduced and gradually replaced by new and more effective approaches. However, since the movement has taken place in a slow pace, the sought-after sustainable development is definitely not around the corner yet. The major features of the historical structure shifting in the marine capture fisheries sector could also present the true picture of the country's shifting fisheries structure.

Vessel structure

Prior to 1975, most of the fishing vessels in Vietnam were generally characterized as artisan (specific to North Vietnam only). After 1975 when Vietnam was united, the number of vessels increased and more than half of the country's fishing vessels were powered, mainly because most of the additional vessels formerly belonging to South Vietnam were motorized. From 1976 to 1980 when the central planning mechanism was strictly adopted across Vietnam, state-run fishing enterprises and cooperatives were on top of the priority for development.

As a consequence, the number of fishing vessels had decreased in terms of quantity and quality. However, between 1981 and 1990 when the new state management principles were introduced that allow for more deregulations whereby economic entities were free to operate on their own, the capture fisheries sub-sector enjoyed advantageous conditions and started to prosper. In late 1990s, the size of the national fleet has almost doubled compared with that of the 80s in terms of quantity and capacity, but the fleet composition remained unchanged, and by 2000, vessels of low capacity (below 45 HP) continued to account for more than 70% of the total number of vessels in Vietnam (**Table 1**).

Occupational structure

Fisheries in Vietnam are prominently operated using traditional approaches where the fishing households are the main provider of the labor force. Vietnam is located in the

Table 1. Vessel structure in marine capture fisheries of Vietnam (1976-2005)

Indicators	1976	1980	1990	2000	2005
Total number of vessels (units)	51,520	44,388	72,723	87,724	-
Powered vessels (units)	34,833	27,128	43,417	76,768	90,880
Total capacity (HP)	543,431	453,915	947,929	3,478,524	5,317,447
Structure of powered vessels (%)		100.0	100.0	100.0	100.0
20 HP and below		47.4	56.5	39.7	-
20-45 HP		40.1	41.4	33.3	-
45-140 HP		12.0	1.7	13.5	-
140 HP and above		0.5	0.4	13.5	7.2
Average capacity (HP/vessel)	15.6	17.7	21.8	46.7	58.5
Fishing productivity (metric tons/HP)	1.12	0.88	0.75	0.37	0.38

Sources: *Institute for Economic and Planning, Ministry of Fisheries (1998); Draft of the Master Plan for Shifting Structure of the Capture Sector within 1996-2010, Ministry of Fisheries (2006); and Summary Report on the Effects of the State Plan of the Fisheries in 2005*

Table 2. Occupational structure of the marine capture fisheries of Vietnam (1976-1995)

Gear types	1976: % of total number of the same gear type	1995: % of total number of the same gear type)
Trawlers	65.8	26.2
Purse seiners	8.2	4.3
Gill netters	9.4	34.4
Lift netters	13.5	5.6
Long liners	7.0	13.4
Fixed trappers	3.1	7.1
Others	3.0	9.0

Sources: *Institute for Economic and Planning, Ministry of Fisheries (1998), and Draft of the Master Plan for Shifting Capture Pattern within 1996-2010*

tropical zone and gifted with abundance and wide variety of fish species but the fishing pattern is varied, inevitably scattered and inefficient. The official statistical data from 1976 to 1995 (Ministry of Fishery, 1998) indicated that there were more than 20 kinds of fishing gears employed that could be classified into seven main groups (**Table 2**).

The different gear types were distributed across the whole country, and in central Vietnam and the Gulf of Tonkin where pelagic fisheries are popular, drift nets and trawls were common accounting for 60.8% and 13.7% of the gear used, respectively. In the eastern and southwestern parts of Vietnam, trawling is more commonly practiced, representing approximately 38.1% of the total, a pattern considered appropriate for the existing fisheries resources in these areas where demersal species are abundant with the potential production reported to reach about 620,850 mt, representing 74.8% of the total production capacity of the area.

However, the pattern of gear employed seems to be not suitable for fishing operations in the central part and the Gulf of Tonkin since the ratio of pelagic to demersal fishes in these areas was estimated to be about 57.3% to 42.7%, while the proportion of trawlers remained at 13.7%. Moreover, one third of the total trawlers in the Gulf of Tonkin target the economically high value fishes while the rest go for shrimps.

Production structure

The catch composition from marine capture fisheries in Vietnam was also different in the areas although on the whole, the catch comprises: 81.1% fish, 7.6% shrimps, 6.7% cuttlefish, and other species about 4.6% (Ministry of Fisheries, 1995). Recently, the fishermen have put much greater emphasis on targeting the species of high commercial value such as shrimps, cuttlefish, groupers, red snappers, sharks, tunas, etc.

Fishing ground structure (inshore and offshore)

Most fishing activities in Vietnam are operated along the coastal areas, which resulted in the rapid increase in the total number of vessels and fishing gears, and eventually to an alarming depletion of the natural aquatic resources. The consequences of which could be in terms of reduced economic efficiency as well as a downgraded environment. After the introduction of a state policy on capital credit preference for building offshore fishing vessels in 1997, the country's vessel fleet had witnessed a marked shift towards increased number of offshore vessels, although the results have still been insignificant. At the end of 2003, the number of powered fishing vessels stands at 83,122 with a total capacity of 4,100,000 HP with an average of 49.32 HP/vessel. About 24.3% of the total powered vessels were sufficiently equipped for offshore fishing operations. Thus, production from offshore operations in 2003 was estimated at 533,000 mt representing about 38.8% of the total fisheries production (it was about 20.0% in 1995). **Table 3** shows the total marine capture fisheries production of Vietnam by fishing area from 1995 to 2005.

Sectoral structure

Prior to the introduction of far-reaching reforms in 1986 and when central planning was predominant, marine fisheries were categorized into three sub-sectors, namely: state-run, co-operative and private. From 1960 to 1970, the state-run and co-operative sub-sectors occupied almost the upper half of the structure, but in the following decade when these

Table 3. Marine capture fisheries production of Vietnam by fishing area (1995-2005)

Fishing Areas	1995		2005	
	Volume (mt)	%	Volume (mt)	%
Tonkin Gulf	42,200	4.4	88,238	4.9
North Central Vietnam	86,750	9.1	166,957	9.2
South Central Vietnam	288,770	30.3	379,708	21.0
Southeast Vietnam	524,310	54.9	411,173	22.7
Southwest Vietnam	-	-	728,015	40.2
Total	942,030	100	1,809,689	100

Sources: *Institute for Economic and Planning, Ministry of Fisheries (1998); Draft of the Master Plan for Shifting Structure of the Capture Sector within 1996-2010; Ministry of Fisheries (2006); and Summary Report on the Effects of the State Plan of the Fisheries in 2005*

two sub-sectors revealed many inherent shortcomings and became less advantageous in terms of competition, these were gradually replaced by the fishing households.

On the other hand, the private sector has been the driving force in the marine capture fisheries sector, delivering increased production compared to only about 0.1% from state-owned entities. Among the reasons for this was the fact that most of the state-run fishing enterprises have been dissolved or have shifted its primary functions from fishing into logistic services, and only a few remained in the fishing business.

Aquaculture Development

With great potentials and advantages of growth of various aquatic species, aquaculture has so far registered a very remarkable development in Vietnam. Before the 80s, aquaculture production was negligible and could not be considered as an industry in itself. From 1985 to 1995 however, the average growth rate of the aquaculture production was recorded at 109% per year which produced about 459,950 mt in 1995. In the following ten-year period from 1996 to 2005, the growth rate averaged at 115% per year, with an increase of 17% per year in 2000-2005, yielding 1,437,400 mt in 2005 (42% of the total fisheries production of Vietnam). The total area used for aquaculture was 959,900 ha in 2005 (about 46.8% of the total potential area for aquaculture). The marvelous development of aquaculture in Vietnam in the past years was the result of concerted efforts from many major players in the economy. From the sectoral structure perspective, many features have contributed to the fast development of the aquaculture sub-sector of Vietnam.

Water surface areas

In the nine-year period from 1995 to 2003, there was a shift in the usage of the water surface areas mainly in ponds, small lakes, ditches, reservoirs, and tidal areas as shown in **Table 4**. Moreover, the recently promoted and encouraged sea ranching scheme by the government, has been considerably developed in many provinces such as in Quang Ninh, Hai Phong, Binh Dinh, Phu Yen, Khanh Hoa, Binh Thuan, Ninh Thuan, Ba Ria-Vung Tau, etc.

Cultured species

The main species cultured in Vietnam are various fishes and shrimps (in brackish and marine environments), mollusks (oysters, shells) as well as freshwater species such as frogs, eels, tortoises, etc. In recent years, the species that have been strongly developed are shrimps (with the white leg species in some areas), tra-basa catfish and some special species such as sweet snails, sea crabs, and oysters. **Table 5** shows the species groups being cultured in various environments in Vietnam.

Production systems

Almost all aquaculture farms in Vietnam are operated by households in scattered areas using small and artisanal production methods such as extensive and improved extensive (semi-intensive) farming. Some industrial farming

Table 4. Water surface areas available and used by for aquaculture in Vietnam (1995-2003)

Categories	Potential areas		Areas used (to 1995)		Areas used (to 2003)	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Ponds, small lakes, ditches	120,000	5.9	-	-	100,986	84.2
Reservoirs	340,000	16.6	100,000	29.4	56,272	16.6
Paddy fields where aquaculture is appropriate	580,000	28.3	85,000	14.7	68,449	11.8
Tidal areas	660,000	32.2	275,000	41.7	575,137	87.1
Others	350,000	17.0	121,000	34.3	25,407	-
Total	2,050,000	100.0	581,000	28.3	902,229	44.0

Sources: *Institute for Economics and Planning, Ministry of Fishery (1998), Draft of The Master Plan for Fishery Development to 2010; Ministry of Fishery (2005), Fisheries Statistics of Vietnam 2001- 2003.*

Table 5. Cultured species in Vietnam by water environments (2001-2003)

Environments and species	2001		2002		2003	
	Volume (mt)	%	Volume (mt)	%	Volume (mt)	%
Marine and Brackishwater	319,071	45.0	396,099	47.0	443,135	44.0
Shrimps	149,978	21.1	181,851	21.5	233,086	23.2
Finfish	37,833	5.3	44,594	5.5	56,270	5.6
Other sp.	131,259	18.6	169,654	20.1	153,779	15.3
Freshwater	390,820	55.0	448,710	53.0	559,960	56.0
Shrimps	4,933	0.6	4,364	0.5	4,794	0.5
Finfish	383,186	54.0	441,827	52.3	548,131	54.6
Other sp.	2,701	0.4	2,519	0.3	7,035	0.7
Total	709,891	100.0	844,809	100.0	1,003,095	100.0

Sources: *www.fistenet.gov.vn (2005), Fisheries Statistics of Vietnam 2001-2003*

activities are also in operation which account for about 25% of the farms that have been intensively invested. In recent years, farming methods and practices have been improved in order to respond to the rigid export market requirements. This requires a systematic shifting in the aquaculture pattern, guided by science-based planning and stricter management policies of the aquaculture activities.

Many developments can thus be seen from many angles, for example in constructing an irrigational infrastructure for aquaculture; monitoring the sources of broodstock, proper management of feeds and the aquatic habitat, preventing the occurrence of aquatic diseases without using excessive antibiotics as well as applying the management models of good aquaculture practices (i.e., BMP, GAP, CoC, etc.) .

In addition to diversifying the species cultured which should be of commercial value and the culture systems, some aquaculture operators have established breed-producing facilities to get a firm hold on the broodstock supply and also to restock the depleted natural resources. Until 2005, there were 4,281 shrimp breeding farms producing 28.8 billion post larvae and 392 broodstock units producing 17.45 billion of milkfish fry.

In short, aquaculture has achieved both rapid growth rate and high economic efficiency. This can then be translated into changing the economic pattern in rural and coastal areas by means of creating new jobs, increasing income, eliminating hunger, and reducing poverty. The aquaculture structure has gone from reducing production methods that are spontaneous, unplanned, self-sufficient and highly dependent on natural resources to intensifying large-scale production that can accommodate the huge demands of the local consumers and the export markets. However, there are many things that need to be done in the transitional process in order to achieve sustainable aquaculture development. Several factors cited include proper water surface area planning, infrastructure construction and improvement, technological progress application, and the selection of proper production methods and inputs.

Fish Processing

From the point of view of the whole economy, fisheries processing is an integral component of the food industry and fisheries production system is only one stage of the whole process. In this stage, raw materials from capture fisheries and aquaculture could be processed into many kinds of food products that suit the consumers' tastes and habits in different locations at different times. It is where new values are added and at the same time, the consumers' needs and wants are incorporated to produce the appropriate fish products with new attributes. Therefore, fisheries production has a direct connection to changes in consumer demands over periods of time.

Additionally, the switch also reflects the requirement of increased economic efficiency not only for aquatic processing itself but also for capture and aquaculture. Such diversified pattern in turn allows the diversification of seafood products and the minimization of post-harvest losses, as it plays a major part in solving inherent conflicts in sector development, notably between the comparatively stable nature of fish species and consumers' diverse and fast-moving demands. Furthermore, the shift in the fisheries processing structure is also regarded as a leverage to encourage the structural change in capture fisheries and aquaculture in conformity with market needs.

The advancement of fisheries processing, especially the export-oriented sub-sector could be considered as a breakthrough in the development of the whole fisheries structure, creating the foundation for new economic management methods adopted in the past years. Before 1980s, fisheries processing was a simple and traditional economic activity that includes fish sauce processing, and fish drying and salting, with the products mainly sold in

Table 6. Structure of the processed fish products in Vietnam (by volume)

Products	2000		2002		2004	
	Volume (mt)	%	Volume (mt)	%	Volume (mt)	%
Fish	68,479.13	23.46	149,951.02	32.69	201,135.63	37.86
Shrimp	67,420.43	23.10	115,855.13	25.26	142,206.65	26.76
Cuttlefish	61,086.51	20.93	73,799.25	16.09	72,209.08	13.59
Others	94,936.61	32.52	119,052.58	25.96	115,774.49	21.79
Total	291,922.68	100	458,657.98	100	531,325.85	100

Sources: *Compiled based on the statistical data of the Informatics Center, Ministry of Fisheries (2005)*

Table 7. Structure of the processed fish products in Vietnam (by value)

Products	2000		2002		2004	
	Value (USD)	%	Value (USD)	%	Value (USD)	%
Fish	205,102,156	13.90	479,323,866	23.70	567,698,445	23.65
Shrimp	658,213,061	44.59	965,792,440	47.74	1,272,331,198	53.00
Cuttlefish	109,918,471	7.45	249,428,043	12.33	233,041,195	9.71
Others	502,830,507	34.07	328,276,567	16.23	327,710,277	13.65
Total	1,476,064,195	100	2,022,820,916	100	2,400,781,115	100

Sources: *Compiled based on the statistical data of the Informatics Center, Ministry of Fisheries (2005)*

domestic markets. After 1981, production of frozen fish products for export grew quickly, resulting in increased number of enterprises, freezing capacity and hence, export values. The annual average growth rate of this export-led sub-sector was recorded at 108% in terms of number of factories; 121% in capacity and 117% in export value from 1996 to 2005 (**Table 6** and **Table 7**).

The fisheries processing structure of Vietnam (from the product patterns in the market shown in **Table 8** and **Table 9**), has been heading towards diversification in order to meet market demands and focusing on commodities of high export values (high value-added products accounted for 40-50% in 2005) and in 2000-2005, the market structure has been more diversified. Prior to 1995, about 70% of the national export of seafood products was bound for Japan with the remaining 30% delivered to other Asian markets such as Hong Kong and Taiwan. Later, the market had been expanded to include high-end markets such as Europe and the USA. At the end of 2005, fish and seafood products from Vietnam were already very visible in the markets of 105 countries and territories.

The changing structure of commodities and extending markets made Vietnam overcome the barriers to trade such as regulations of quality standards as well as the anti-dumping policy of large and demanding markets in Europe and the US. However, as in other economic areas, the shifting of the fisheries processing structure was mainly in terms of quality standards while the application of new technology and value addition to seafood products have been progressing rather slowly. While some 50% of exported frozen fish and seafood is still in the preliminary stages of processing, both product quality and management quality have exposed imminent threats against unsustainability.

Orientations for Shifting the Fisheries Structure

From the prevailing practices of structure transformation in the fisheries sector in the past decades, some significant features can be observed. For example, the shift in the fisheries structure was implemented with a rather slow start. Considering the backward socio-economic conditions of the sector, some form of structure shifting was carried out without proper planning, and remained unstructured and unchecked for a long period of time. The structure shifting in fisheries played a part in transforming the sector from a small component of the whole agricultural system to an independent production sector that made great contributions to the economy. Since the shift in the fisheries structure was closely connected to reforms of management institutions/ mechanisms that governed the economy, the process also generated impulses to speed up innovations and reforms. The structure shifting has generally led the sector forward to a rapid and sustainable development, helping Vietnam to integrate its economy into the regional and global economies. In order to achieve the goal of "rapid and sustainable growth" as provided for in the Master Plan for Fisheries Development to 2010, which was approved by the government in January 2006, the fisheries structure should be pushed forward following predefined orientations. In general, the whole system of fisheries production must be shifted from the natural resource intensive based to technology intensive.

Table 8. Market structure of Vietnam's processed fish products (by volume)

Markets	2000		2002		2004	
	Volume (mt)	%	Volume (mt)	%	Volume (mt)	%
Asia (excluding Japan)	106,779.27	36.58	134,744.06	29.38	123,891.10	23.32
Europe	20,290.78	6.95	28,612.78	6.24	73,459.21	13.83
America	37,979.87	13.01	98,664.54	21.51	91,380.69	17.20
Japan	68,717.19	23.54	96,251.41	20.99	121,160.49	22.80
Other markets	58,155.57	19.92	100,385.20	21.89	121,434.36	22.85
Total	291,922.68	100	458,657.99	100	531,325.85	100

Sources: *Compiled based on the statistical data of the Informatics Center, Ministry of Fisheries (2005)*

Table 9. Market structure of Vietnam's processed fish products (by value)

Markets	2000		2002		2004	
	Value (USD)	(%)	Value (USD)	(%)	Value (USD)	(%)
Asia (excluding Japan)	412,396,176	27.89	497,803,341	24.61	413,861,348	17.24
Europe	71,782,420	4.85	73,719,852	3.64	231,527,515	9.64
America	301,303,916	20.3	654,977,324	32.38	602,969,450	25.12
Japan	469,472,915	31.75	537,459,466	26.57	772,194,720	32.16
Other markets	223,654,122	15.13	258,860,933	12.80	380,228,081	15.84
Total	1,478,609,549	100	2,022,820,916	100	2,400,781,114	100

Sources: *Compiled based on the statistical data of the Informatics Center, Ministry of Fisheries (2005)*

Orientations for the Sectoral Structure

The relationship between aquaculture and industrial fisheries mirrors the same relationship as with agriculture and the industry. As such the thrust of aquaculture must be changed from being natural and self-sufficient production sector to commodity production to ensure the supply of diverse commodities for the consumers and to supply the raw materials for

processing. The structure of aquaculture and capture fisheries must be transformed in accordance with the predefined orientations as provided for in the National Master Plan for Agriculture-Forestry-Fisheries Pattern Shifting to 2010 approved by the Prime Minister in June 2004.

For aquaculture

Based on the National Master Plan, aquaculture is expected to increase fish production from brackishwater culture and searanching and at the same time, develop freshwater culture in ponds, small lakes, rivers and reservoirs. Identifying potential groups of main aquaculture species considering the bio-ecological environment of each area, region and at the same time also supplying market demands is also mandated for the aquaculture sector in the Plan. Moreover, investing into industrial and intensive zones of shrimp culture, applying the standards of safe and sanitary food to farming zones, intensifying the protection of the ecological environment and biodiversity, and readjusting the aquaculture structure according to the Master Plan, have been put forward for the aquaculture sector to undertake in order to gain high economic efficiency.

For capture fisheries

Transforming quickly occupational structure and stabilizing capture fisheries production in coastal areas while increasing offshore production have been included in the orientation for the marine fisheries sub-sector. In addition, the whole marine water resources should be divided into manageable areas so that monitoring, control and supervision activities can be efficiently put in effect. Furthermore, decentralization and authority delegation should be the guiding principles in the administration of fishing operations while fishing ports systems should be better equipped, and fishing logistics and services should be enhanced.

For fish processing industries

The expansion of the fish processing sub-sector should comply with general orientations for fisheries development, specifically referring to the fact that capture fisheries that is based on simple natural resource utilization, should be gradually reduced. Processing instead should take the center stage to enhance the initial values of the natural aquatic resources and bring additional values to the economy by producing high-end, instant consuming products. This could be an appropriate answer to the condition of the country's aquatic resources which are characterized by multi-species but small stocks.

Sectoral Development Orientations

For the State-run Sector

The government should ensure that logistics services are provided for the other economic sectors, such as production services by constructing fishing ports, building and repair of fishing vessels, providing materials and equipment, adopting modern technologies, providing broodstock and feeds for aquaculture, etc. In addition, the government is also encouraged to provide technical services through conduct of scientific training and technological transfer activities. Services to accommodate the physical and spiritual life for fishermen should also be promoted. Providing processing services and seeking outlets for seafood products from the other economic sectors are also the responsibility of the State. In addition, the State should represent all the other economic sectors to cooperate with foreign business partners.

For the Other Economic Sectors

The other economic sectors such as cooperatives, private sector, households, etc. should continue to play decisive roles as the driving force for fisheries product development, especially from capture fisheries and aquaculture. This strength could be enhanced with the concerted coordination efforts among all sectors, i.e. Agriculture, Forestry, Fisheries, Irrigation, and Marine Economy.

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CALENDAR OF EVENTS

Date	Venue	Title	Organizer
		2009	
12-15 January	Samut Prakan, Thailand	1st Expert Meeting and Regional Workshop on the Reduction of the Impacts of Fishing Gear in Coastal and Marine Environment in the Southeast Asian Water	TD
12-21 January	Samut Prakan, Thailand	Regional Training Course on Local/Indigenous Institution and Co-management (HRD Activities on Thematic Area)	TD
12-21 January	Malaysia	HRD Training of Inland Fisheries Development	MFRDMD
20-22 January	Honolulu, USA	Technical Workshop on Minimizing Sea Turtle Interactions in Coastal Net Fisheries	IOSEA
26-30 January	Rome, Italy	Technical Consultation to draft a legally-binding instrument on port State measures to prevent, deter and eliminate illegal, unreported and unregulated fishing (FI-807) (resumed session)	FAO
28-29 January	Bangkok, Thailand	National Workshop on the Development of Status and Trends for Capture Fisheries and Aquaculture (STF) in Thailand	Secretariat
30 January	Bangkok, Thailand	Workshop on Certification and Eco-labelling	SEAFDEC-Sida
1-3 February	To be confirmed	Regional Forum on the MRC Climate Change and Adaptation Initiative	MRC
4-18 February	Philippines	Hands-on training on fish health management	AQD
10-12 February	Bangkok, Thailand	ASEAN-SEAFDEC Regional Technical Consultation on International Fisheries Related Issues	Secretariat
17-19 February	Brisbane, Australia	29th Symposium on Sea Turtle Biology and Conservation	International Sea Turtle Society
23 Feb-13 Mar	Philippines	Training on freshwater aquaculture	AQD
24-26 February	Bangkok, Thailand	Sub-Regional on Gulf of Thailand Meeting	SEAFDEC-Sida
2-6 March	Rome, Italy	COFI - Committee on Fisheries - 28th Session	FAO
3-11 March	Singapore	Regional Train-the-Trainer Workshop on Backyard Fishery Post-harvest Technology	MFRD
5-6 March	Bangkok, Thailand	5th International Symposium on SEASTAR2000 and Asian Bio-logging Science (The 9th SEASTAR2000 Workshop)	SEASTAR
9-11 March	Rome, Italy	2nd Meeting of Regional Fishery Body Secretariats Network	FAO
9-11 March	Rome, Italy	Meeting on Climate Change: Impacts, Adaptation and Mitigation in Fisheries and Aquaculture & WorldFish and QUEST_ Fish Scenario-building Workshop	FAO
10-24 March	Philippines	Training on cage/pond culture of high-value fishes (grouper/snapper/seabass)	AQD
23-27 March	Lao PDR	1st HRD Workshop for the Promotion of "One Village, One Fisheries Product (FOVOP)" in Lao PDR	Secretariat
23-24 March	Bangkok, Thailand	Preparatory Meeting for ASEAN Fisheries Consultative Forum	DOF/Sida
25-27 March	Bangkok, Thailand	Vessel Record and Inventory	SEAFDEC-Sida
14 Apr-5 May	Philippines	Training on crab hatchery and grow-out	AQD
4-8 May	Lao PDR	2nd HRD Workshop for the Promotion of "FOVOP" in Lao PDR	Secretariat
11-15 May	Manado, Indonesia	World Ocean Conference 2009-"Climate Change Impacts to Oceans and The Role of Oceans to Climate Change"	WOC
12-14 May	United Arab Emirates	RECOFI -Regional Commission for Fisheries - 5th Session	RECOFI
19 May-24 Jun	Philippines	Training on marine fish hatchery	AQD
June (tentative)	To be confirmed	Meeting of the Sub Regional: Andaman Sea	Sida
3-23 July	Philippines	Training on abalone hatchery and grow-out	AQD
23-27 November	Manila, Philippines	East Asian Seas Congress 2009	EAS

Southeast Asian Fisheries Development Center (SEAFDEC)

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

Objectives
SEAFDEC aims specifically to develop fishery potentials in the region through training, research and information services in order to improve food supply through rational utilization of fisheries resources in the region.

Functions
To achieve its objectives the Center has the following functions:
1. To offer training courses, and to organize workshops and seminars, in fishing technology, marine engineering, extension methodology, post-harvest technology, and aquaculture;
2. To conduct research and development in fishing gear technology, fishing ground surveys, post-harvest technology and aquaculture, to examine problems related to the handling of fish at sea and quality control, and to undertake studies on the fisheries resources in the region; and
3. To arrange for the transfer of technology to the countries in the region and to make available the printed and non-printed media, which include the publication of statistical bulletins for the exchange and dissemination related to fisheries and aquaculture development.

Membership
SEAFDEC members are the ASEAN Member Countries (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam) and Japan.

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In the occasion of the Millennium Conference, a drawing contest was organized for the children among ASEAN-SEAFDEC Member Countries, on the theme of "*Fish and the Culture*". This is the second best drawing from Malaysia.