

FISH for the PEOPLE

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Sustainable Fisheries for Rural Development and Poverty Eradication



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Editorial

Fisheries of Southeast Asia has always been considered a sunshine industry in view of its significant contribution to the national economic development of the countries and thus, to the people's socio-economic well-being. Judging from the region's total fishery production *vis-à-vis* the volume of fish and fishery products exported by the countries of the region, the fishery sector contributes about US\$480.00 per year or barely US\$1.30 per day to each fisher or fish worker in the region. How far can this amount save the people especially those in the rural fishing communities from severe poverty?

In 2010, the region's total fishery production was about 31.4 million metric tons, 47% of which was contributed by marine capture fisheries, 45% by aquaculture, and 8% by inland capture fisheries. While production from marine capture fisheries had been following an almost steady trend, a bright future lies in the aquaculture and inland capture fisheries sub-sectors. Even if inland capture fisheries accounted for only a minimal portion of the region's total fishery production, the rich inland fishery resources that abound in the Southeast Asian region could be sustainably developed and exploited in order that this sub-sector could sustain a substantial contribution to food security especially for those whose livelihood hinges on the available natural inland resources. This is notwithstanding the production of high-value aquatic species from responsible aquaculture practices that could command high prices in the world market.

Since most inland fishery resources are still taken as low-value by consumers who prefer the high-value species from marine fisheries and aquaculture, value-adding to the freshwater fish could be an option so that fishers in rural communities could get the maximum benefits from their catch, considering that these are the same fishers who belong to the most marginalized groups in society. The incessant poverty of fishers in spite of the available natural resources is therefore a great concern that needs urgent attention in order that the contribution of fisheries to food security could become a vivid reality.

With improved fisheries management, the total fisheries production of Southeast Asia can continue to provide the food fish requirements of its people, and still generate a surplus sufficient enough for marketing to importing countries or processing into value-added products to boost the supply for domestic consumption. Moreover, the fisheries sector employs more than 45 million people

C O N T E N T S

including women and youth in the processing industries and in marketing. Although these fish workers comprise only about 8% of the region's total population in 2010, it is because of them that we can find fish and fishery products in our tables. It is therefore for these groups of fish workers that livelihood opportunities in rural communities must be enhanced, and bearing this concern, SEAFDEC conducted projects in 2010 that aimed to alleviate poverty in rural fishing communities. With financial assistance from the ASEAN Foundation, the project on One Village, One Fisheries Product or FOVOP was meant to snowball the creation of economic activities in the rural communities through the promotion of alternative livelihoods that could alleviate poverty. The resulting Regional Guidelines on FOVOP was meant to serve as a common framework for mobilizing FOVOP in Southeast Asia. Meanwhile, through the other project on Human Resource Development on Poverty Alleviation and Food Security by Fisheries Intervention, regional policy recommendations on responsible fisheries management, aquaculture and fishery post-harvest technologies were intended for possible mainstreaming in the respective policies of the countries that are aimed at alleviating poverty in fishing communities.

This time, it has become important to assess the increasing demand for food fish which is set into motion by the rapid growth of the population coupled with the changing attitude of the people to eat more fish for health reasons. This situation adds pressure to the fishery resources and increases the dynamism and competitiveness of the multiple uses of the resources. Given such scenario, the region is likely to continue to experience continuous decline of its fishery resources due to over-exploitation and irresponsible utilization of resources leading to habitat degradation and creating challenges on how sustainable fisheries could be achieved. It is in this aspect that SEAFDEC with its technical capability is advocating the adoption of the ecosystem approach to fisheries management which is anchored on the 2011 Resolution and Plan of Action. Guided by these instruments, SEAFDEC will also continue to strengthen the linkage between sustainable fisheries and healthy ecosystem, intensify rural development as means of rooting out poverty in the fishing communities of Southeast Asia, and steer the Southeast Asian countries towards achieving the common vision adopted at the recently conducted Rio+20 which stressed on *“the crucial role of healthy marine ecosystems, sustainable fisheries and sustainable aquaculture for food security and nutrition and in providing the livelihoods of millions of people”*.

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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.

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Approaches for the Sustainable Development and Management of Fisheries in the Southeast Asian Region

Somnuk Pornpatimakorn

The Southeast Asian region which is one of the most important areas of the world in terms of economic development, currently embraces ten Member Countries of the Southeast Asian Fisheries Development Center (SEAFDEC), namely: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The region is also significant to the world's food supply since it accounts for more than 30% of the world's total agricultural production, and supplies almost 20% to the world's total fisheries production. This article offers suggestions for enhancing the sustainable development and management of fisheries in the Southeast Asian region.

While fisheries production from many regions of the world appears to be declining, production from Southeast Asia continues to steadily and significantly increase. The Southeast Asian region (**Fig. 1**) envelopes the most important and abundant oceans and seas of the world, such as the Andaman Sea on the west, the Indian Ocean in the south and west, and the South China Sea and western part of Pacific Ocean on the east. It also encompasses the floodplains of the Lower Mekong River Basin which is one of the world's richest areas in terms of freshwater biodiversity. The fishery resources in these waters are by nature tropical and multi-species, and are being exploited by multi-gear fisheries involving large numbers of peoples who are mainly engaged in small-scale or artisanal fishing and small-scale fish farm operations.



Fig. 1. Map of Southeast Asia

The geographical features of the Southeast Asian region create certain sub-areas that share common fishery resources. While the over-all fisheries production of the region appears to be increasing, in some particular sub-areas production could have already declined in view of the severe state of over-exploitation of their fishery resources. As a whole, since fisheries play a very critical role in the economic development and food security of the region, approaches for the innovative and sustainable development and management of the fisheries at the regional level should therefore be urgently established, notwithstanding the disputes in some sub-areas over the use of the resources.

Fisheries Production from Southeast Asia

In 2009, the fisheries production from the Southeast Asian region provided about 20% to the world's total fishery production. More particularly from 2000 to 2009, the region's fisheries production provided significant contributions to the world's total fisheries production (**Table 1**). Among the top fish producing countries of the region, Thailand experienced a decreasing trend of its fisheries production due to the declining marine fisheries resources in the Gulf of Thailand. During the same period, drastic reduction of fisheries production had also been recorded in transboundary fishing areas shared with Thailand, *i.e.* in Indonesia, Malaysia, and in some countries bordering the Andaman Sea.

In the absence of proper catch documentation in the past, catches from these waters which were landed in Thailand could have been erroneously recorded as part of the fisheries production of Thailand. The decreasing catches from such areas could have also greatly affected the statistics on the total fisheries production of Thailand.

Although marine capture fisheries had always been the most important subsector in terms of fishery production, the contribution from this sub-sector had gone down to less than 50% in 2009 from almost 60% in 2005 (**Table 2**). Inland capture fisheries had been playing very important role in providing the main source of protein especially for the poor and rural people. This sub-sector has been contributing more than 8% to the region's total fisheries production. As another important sub-sector for economic development, aquaculture contributed about 33% to the region's total fisheries production in 2005 which increased

Table 1. Total fishery production of the Southeast Asian region* (metric tons)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brunei Darussalam	2,577	1,575	2,152	2,160	3,133	3,103	3,100	3,227	2,747	2,418
Cambodia	298,798	441,200	424,432	390,657	343,492	546,000	661,542	525,100	536,320	515,000
Indonesia	5,120,490	5,409,504	5,515,648	5,915,989	6,005,622	6,646,965	7,183,586	7,510,767	9,054,873	10,064,140
Lao PDR	71,000	81,000	93,000	95,000	95,000	107,800	107,800	91,660	93,500	105,000
Malaysia	1,456,932	1,411,740	1,467,486	1,483,957	1,536,990	1,402,404	1,596,051	1,654,221	1,639,017	1,729,002
Myanmar	1,309,830	1,474,460	1,606,240	1,987,020	2,148,580	2,581,780	2,817,990	2,808,037	3,147,605	3,491,103
Philippines	2,993,292	3,166,528	3,369,524	3,619,282	3,926,173	4,161,869	4,412,158	4,710,952	4,964,703	5,084,674
Singapore	9,984	7,784	7,795	7,109	7,579	7,837	11,675	8,026	5,141	5,687
Thailand	3,713,248	3,648,429	3,797,014	3,914,025	4,137,066	4,132,826	4,051,824	3,675,382	3,204,200	3,137,672
Vietnam	1,961,145	2,009,623	2,647,407	2,859,200	2,944,030	3,397,200	3,656,152	4,315,500	4,559,720	4,782,400
Region's Total	16,937,296	17,621,843	18,930,761	20,274,399	21,147,665	22,987,784	24,501,878	25,302,872	27,207,826	28,917,096
World's Total**	131,000,000	130,700,000	133,000,000	132,200,000	134,300,000	136,400,000	137,100,000	139,800,000	142,300,000	145,100,000
Contribution of the region's to world's total fish production	13.0%	13.5%	14.2%	15.4%	15.8%	16.9%	17.9%	18.1%	19.1%	20.0%

*Sources: Fishery Statistical Bulletin for the South China Sea Area (SEAFDEC, 2000-2010)
Fishery Statistical Bulletin of Southeast Asia (SEAFDEC 2010, 2011)

**Source: FAO Fisheries and Aquaculture Information and Statistics Services

Table 2. Share of the fisheries sub-sectors in the total fisheries production of the Southeast Asian region

Sub-sector	Production (metric tons)		% Contribution to Total Fisheries Production	
	2005	2009	2005	2009
Marine Capture Fisheries	13,587,280	14,140,387	59.1	48.9
Inland Capture Fisheries	1,888,289	2,397,273	8.2	8.3
Aquaculture	7,512,534	12,379,436	32.7	42.8
Total	22,988,103	28,917,096	100.0	100.0

Source: Fishery Statistical Bulletin of Southeast Asia (SEAFDEC, 2011)

to 43% in 2009. However, a large portion of aquaculture production is intended mainly for export with only little portion meant for domestic consumption.

Marine Capture Fisheries Production

The contribution of the region's marine capture fisheries production to the world's total marine capture fishery production was about 18% in 2009. Ranked as the region's largest producer, Indonesia accounted for about 30% of the region's total marine capture fishery production while the Philippines contributed 17%. However, big portions of the production data from most countries had been reported only as either miscellaneous fishes or Osteichthyes or marine fishes *nei* and non-fish groups such as cuttlefish, squids, shrimps, and other crustaceans (SEAFDEC, 2011). This makes classifying the marine capture fisheries production into demersal or pelagic group impossible to reckon with. Nevertheless, Lymer *et al.* (2010) suggested that most of the marine fishery resources in the region could be almost fully exploited or in some cases overexploited taking into account the estimated maximum sustainable yield (MSY)

and production trend (**Table 3**). Considering such scenario, the establishment of appropriate regional strategies that aim for the sustainable development and management of the fishery resources is therefore urgently needed.

Inland Capture Fisheries Production

People living near rivers and other inland water bodies are mainly dependent on freshwater fish and fishery products for food and income. Since large portion of the catch from inland capture fisheries are directly utilized for household consumption, accurate data on the production from inland capture fisheries rarely exist for this region. The current information on inland capture fisheries production (**Table 4**), which is based on available statistics compiled at the national level, indicated that production from 2000 to 2009 has gone through a see-saw fluctuating pattern. After experiencing a sharp decline in 2004, production increased in 2005-2006, down again in 2007, sharply increased in 2008, and finally increased again by about 2.8% in 2009. Generally, inland capture fisheries production of the region had been provided mainly by the countries bordering the

Table 3. Total fish catch and estimated MSY for selected countries in Southeast Asia

Country	Year	Catch (mt)	Estimated MSY (mt)	Fishing Area/Remarks
Vietnam	2004	1,724,200	1,500,000-1,600,000	Gulf of Tonkin (total biomass estimated at 5,075,143 metric tons; demersal biomass - 11,174,261 mt; large pelagic biomass - 1,156,032; small pelagic biomass - 2,744,850 mt)
	2008		582,212	Nearshore zone (50 m depth)
Thailand	2007	1,447,898	2,159,049	Gulf of Thailand
	2007	631,453	912,943	Andaman Sea
Indonesia	2008	4,702,933	5,120,000	National total
			66,100	Fisheries Management Area (FMA) 711: Large pelagic group
			621,500	FMA 711: Small pelagic group
			334,800	FMA 711: Demersal group
			11,900	FMA 711: Penaeid shrimps group
			27,700	FMA 571: Large pelagic group
			147,300	FMA 571: Small pelagic group
			82,400	FMA 571: Demersal group
			11,400	FMA 571: Penaeid shrimps group
			164,800	FMA 572: Large pelagic group
		315,900	FMA 572: Small pelagic group	
		68,900	FMA 572: Demersal group	
		4,800	FMA 572: Penaeid shrimps group	
Malaysia	2008	1,409,929	1,616,988	National potential yield
Philippines	2008	2,559,191	2,500,000	National report
Myanmar	2007	1,679,000	1,050,000	National figure based on marine fishery stock assessment survey conducted by FAO from 1980 to 1983

Adapted from Lymer et al. (2010)

Table 4. Production from inland capture fisheries of the Southeast Asian region (metric tons)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Cambodia	245,600	360,000	360,300	308,750	250,00	444,000	559,642	420,000	430,600	390,000
Indonesia	318,334	310,240	304,989	308,693	330,880	297,370	293,921	310,457	497,740	494,630
Lao PDR	...	...	...	...	...	29,800	29,800	28,410	29,200	30,000
Malaysia	3,549	3,446	3,565	3,828	4,119	4,583	4,164	4,283	4,353	4,469
Myanmar	238,210	254,880	289,940	454,320	502,550	631,120	718,000	717,640	814,740	899,430
Philippines	152,351	136,347	131,644	133,292	142,019	143,806	165,081	168,311	179,491	188,444
Thailand	201,500	202,500	198,700	198,400	199,600	198,800	214,000	225,600	228,600	245,500
Vietnam	170,00	243,583	226,958	208,623	...	138,800	152,325	133,600	144,800	144,800
Total	1,159,544	1,510,996	1,516,096	1,615,906	1,179,168	1,888,279	2,136,933	2,008,301	2,329,524	2,397,273

Sources: Fishery Statistical Bulletin for the South China Sea Area (SEAFDEC, 2000-2010)
Fishery Statistical Bulletin of Southeast Asia (SEAFDEC 2010, 2011)

Lower Mekong River Basin (LMRB), namely: Cambodia, Lao PDR, Thailand and Vietnam, as well as by Myanmar and Indonesia.

Aquaculture Production

The aquaculture production from Southeast Asia which accounted for about 17% of the world's total aquaculture production had increased from 3.7 million metric tons in 2000 to 12.4 million metric tons in 2009 (Table 5). Aquaculture therefore has the potentials to fill the gap

between supply and demand for food fish as supply from nature is expected to decline. However, since fish meal still constitutes the essential part of almost all aquaculture feeds, intensifying aquaculture development could lead to increased fishing effort and continued decline of the natural fishery resources.

The major species cultured vary according to the geographical areas and preference of the countries. The main commodity produced by Indonesia is seaweeds comprising about 62% of its total aquaculture production,

Table 5. Total fishery and aquaculture production of Southeast Asia by culture category (metric tons)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Fishery Production	16,937,296	17,621,843	18,930,761	20,274,399	21,147,665	22,987,784	24,501,878	25,302,872	27,207,826	28,917,096
Total Aquaculture Production	3,696,068	4,257,005	4,806,000	5,439,809	6,308,557	7,512,534	8,426,187	9,237,586	11,063,934	12,379,436
Mariculture	1,219,702	1,489,952	2,114,640	2,230,322	2,712,679	3,005,014	3,623,260	3,879,786	4,646,146	4,945,239
Brackishwater culture	1,108,821	1,191,961	1,297,620	1,468,748	1,514,054	1,953,258	1,853,761	2,032,269	2,072,026	2,694,336
Freshwater culture	1,367,545	1,575,092	1,393,740	1,740,739	2,081,824	2,554,262	2,949,166	3,325,531	4,345,762	4,739,861

Sources: Fishery Statistical Bulletin for the South China Sea Area (SEAFDEC, 2000-2010)
Fishery Statistical Bulletin of Southeast Asia (SEAFDEC 2010, 2011)

Table 6. Mariculture production from the Southeast Asian region by major species group (metric tons)

Major groups	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Marine fishes	21971	21,580	29,037	38,504	42,216	70,520	71,099	93,653	245,967	64,279
Marine mollusks	291,122	358,311	495,371	470,724	661,716	672,108	617,095	590,202	588,563	553,401
Aquatic plants	910,635	1,017,136	1,147,212	1,257,452	1,987,178	2,266,406	2,883,247	3,134,993	3,811,616	4,277,095
Others	23,229	388,127	533,988	471,254	201	-	-	-	-	50,464
Total	1,246,957	1,435,154	2,205,608	2,237,934	2,691,311	3,009,034	3,571,441	3,818,848	4,646,146	4,945,239

Sources: Fishery Statistical Bulletin for the South China Sea Area (SEAFDEC, 2000-2010)
Fishery Statistical Bulletin of Southeast Asia (SEAFDEC 2010, 2011)

while Philippines also produced seaweeds (*Euचेuma cottonii* and *Euचेuma denticulatum*) accounting for about 64% of the country's total aquaculture production in 2009. In the case of Vietnam, the main species cultured is the *basa* catfish which accounted for 41%, while Thailand produced mainly the white leg shrimp accounting for 38%, and for Myanmar, the main species cultured is rohu (*Labeo rohita*) which contributed about 67% to the country's total aquaculture production in 2009. Although seaweeds and aquatic plants are not utilized for direct human consumption, their derivatives constituting about

50% of the production are consumed by humans thus, also contributing to food security. Nonetheless, production of aquatic plants or seaweeds contributed more than 86% to the region's total mariculture production (Table 6) and about 35% of the total aquaculture production of the region.

Outlook of Fish Supply and Demand in Southeast Asia in 2020

The world's consumption of fish is expected to increase dramatically in the next decades, due to the ever increasing

Table 7. Fish production and consumption vis-à-vis population: Southeast Asia

Countries	2009 Population (millions)	2009 Fish Production (mt)	Ave per capita fish consumption (kg/person/year)	Estimated Fish Consumption in 2009 (mt)	Estimated Population in 2020 (millions)	Expected Demand for Fish in 2020 (mt)
Southeast Asia	590.6	26,917,096	38.68	23,062,752	688.0	27,169,335
Brunei Darussalam	0.5	2,418	44.04	22,020	0.5	22,020
Cambodia	14.8	515,000	32.97	487,596	17.0	560,490
Indonesia	240.3	10,064,140	31.43	7,552,629	268.0	8,423,240
Lao PDR	6.3	105,000	24.86	156,618	7.5	186,450
Malaysia	28.3	1,729,002	54.40	1,539,520	32.5	1,768,000
Myanmar	50.0	3,491,103	42.75	2,137,500	68.0	2,907,000
Philippines	92.0	5,084,674	53.49	4,921,080	120.0	6,418,800
Singapore	5.3	5,687	23.44	124,232	6.0	140,640
Thailand	65.0	3,137,672	37.97	2,468,050	70.0	2,657,900
Vietnam	88.1	4,782,400	41.47	3,653,507	98.5	4,084,795
World	6,800.0	145,000,000	18.90	-	8,084.0	152,787,600

Adapted from SEAFDEC (2012) and Pongsri (2010)



gear, marketing, and processing. Women comprising large portion of the workers in fisheries, are mostly employed in the fish processing industry.

While fisheries production shows upward trends during the past decades, over-exploitation of the fishery resources has also been reported with overfishing identified as the primary cause of over-exploitation by commercial and small-scale fisheries. It is therefore necessary to refocus the direction of the region's fisheries considering that their possible reduction or collapse could lead to loss of income and employment as well as to reduced per capita fish consumption of many countries in the region.

population and shift in consumers' preference for healthy food. In the Southeast Asian region (**Table 7**), the rapid growth of its population would add pressure on the natural resources due to increasing demand for food fish. The estimated fish supply for the region in the next decade could come mainly from aquaculture as production from capture fisheries is expected to decline. Meanwhile, major portion of production from marine capture fisheries will continue to be used mainly for fish meal to sustain aquaculture production. As more people would be consuming more fish for health reasons, increased fish consumption would put more pressure on the supply to meet the increasing demand for fish.

Fisheries production in 2009 seemed insufficient to supply the demand for fish, so that many countries had to import fish and fishery products for their peoples. Although the consumption of Indonesia and Philippines appeared to be lower than their production, these countries produce seaweeds or aquatic plants which are exported and not meant for direct human consumption. In the case of Thailand and Vietnam, most of their products such as the white leg shrimp and *basa* catfish, respectively are also meant for export. Since many countries in the region are aiming to increase their export of fish and fishery products, the aforementioned trend of fish supply and demand is expected to prevail in the next decade.

Impacts of the Changing Fisheries Structures of Southeast Asia

The fisheries sector accounts for about 10% of the gross domestic product (GDP) and contributes greatly to the economy and food security of the Southeast Asian region as trade in fish which represents a significant source of foreign currency earnings in most countries is expected to continue to grow. The sector employs more than 30 million people while another 60 million people are working in associated industries such as boat building, manufacturing of fishing

The Southeast Asian region encompasses the most important and abundant fishery resources in the world, but most of the waters especially the South China Sea have been declared part of the respective EEZs of countries, resulting in disputes among many countries. Brunei Darussalam, Malaysia, Philippines and Vietnam with China and Taiwan, continue to assert their claims over the Spratly Islands, Paracel Islands and Scarborough Shoal in the South China Sea. The overlapping EEZs in the Gulf of Thailand between Thailand and Malaysia; and among Thailand, Cambodia and Vietnam have been claimed by the countries that border such transboundary areas. Meanwhile, intensive fishing operations are conducted in shallow waters of the continental shelf, putting much pressure on the fishery resources and creating to some extent socio-economic impacts on the affected countries that eventually lead to vigorous claims and disputes. Therefore, considering the deteriorating state of the fishery resources in the region, the whole system of fisheries production must be changed from being natural resource-intensive to technology-intensive.

Capture Fisheries

While marine capture fisheries had developed significantly brought about by the introduction of modern technologies and fishing techniques for commercial and small-scale



fisheries, the number of motorized vessels increased while more efficient fishing gears were developed and fishing grounds in the EEZs and offshore areas had been explored. Aside from exploiting the pelagic and demersal fishes some other expensive invertebrates and crustaceans, *i.e.* shrimps, crabs, squid, and other shellfishes, are also being harvested. While the demersal fishery resources have been reported to be fully exploited or even overexploited, some pelagic fish stocks which are harvested by major fishing gear such as trawl, purse seine, and gillnet among others, could have already reached their maximum sustainable yield. In order to sustain the fishery resources, appropriate strategies and measures for fisheries development and management (**Box 1**) should be considered and subsequently adopted.

Box 1. Suggested measures and options for sustainable development and management of marine capture fisheries

Eliminate IUU fishing: Efforts to eliminate IUU fishing in territorial waters should be intensified which would need good recording of the number of fishing boats and fishing licenses. Excessive fishing efforts especially the number and types of trawlers and purse seiners should be limited to the appropriate size of the fish stocks in certain areas of each country, considering that these two main gears have been identified as the main causes of overfishing especially of the demersal and pelagic fishery resources.

Establish fish *refugia* and promote ecosystem approach to fisheries: Where appropriate, establish fish *refugias* or enforce closure of certain areas as management tool to protect the spawning, nursery or feeding grounds of some important economic demersal and pelagic fish species, and eventually enhance the growth and recruitment of the overfished stocks.

Improve fish stocks through aquaculture-based enhancement and sea ranching: Countries should carry out research programs aimed at producing fry or fingerlings of some economically-important pelagic and demersal species for propagation in appropriate areas as part of sea ranching activities. In Japan for example, halibut and flat fish are being cultured for sea ranching where fingerlings are being nursed until strong enough to survive in natural conditions after releasing in nursery grounds. The fingerlings are protected until becoming mature, after which the areas could be opened for harvesting. These measures could be applied for both pelagic and demersal fish species although in the case of highly migrating pelagic fish species, their migratory routes should also be carefully studied before conducting any sea ranching activities. It should also be noted that sea ranching could be more appropriate for demersal or short distance migratory pelagic fish species but not much for the highly-migratory fish species.

The changing structure of the region's marine fisheries had resulted in increasing number of fishing boats, which as of the recent count appeared to be more than five hundred thousand powered boats used not only for commercial but also for small-scale fisheries. While low engine capacity boats which are used by small-scale fisheries account for more than 70% of the total number of fishing boats in the

region, trawls are used to harvest high-value fishes, shrimps and squids that are meant for export, and trash fish which is mainly supplied to the fish meal industry. Purse seines also produce large amount of pelagic fishes especially the neritic and oceanic tunas which are meant for export and also serve as raw materials for the tuna canning industry.

Consequently, the structure of occupation in fisheries which predominantly uses traditional practices and labor force provided mainly by fishing households had also changed. After the introduction of the trawl and purse seine fisheries which are labor intensive, local and outsourced labor from other sectors have been increasingly mobilized to correspond to the expanding industry. As the need for fishing labor force continues to increase, foreign labors had been sourced from many countries in region, *e.g.* Myanmar, Cambodia and Lao PDR are generally the source of labor for Thailand fisheries, while labor force from Bangladesh, Myanmar, and Indonesia are mobilized in Malaysia.

In the Gulf of Thailand, Indo-Pacific mackerel (*Rastrelliger brachysoma*) is the most economically-important pelagic species. Since the annual mackerel catch had fluctuated year by year, the Department of Fisheries (DOF) of Thailand came up with measures to protect the fish spawning grounds by enforcing closed fishing season from 15 February until 15 May every year and declaring about 26,400 km² area in Gulf of Thailand as *refugia* for the mackerel. Such closure regulation was extended to the Andaman Sea for the period from 1 April to 30 June every year. The effective outcome of such measure has been the recovery of the mackerel stock which could now be exploited up to about 100,000 metric tons per year. However, even with this level of exploitation, the size composition of the marketable mackerel had changed where bigger sized fishes are no longer found in markets. As this signals incidence of overfishing, the DOF plans to enforce new closure area in the inner Gulf of Thailand in 2012. Moreover, the DOF also initiated a propagation program of the mackerel in 2011, and the fingerlings were subsequently released in nursery grounds or fisheries *refugia*. Such stock enhancement measures for the Indo-Pacific mackerel developed in Thailand could also be applied to the Indian mackerel (*R. kanagurta*) which is being significantly harvested by Indonesia, Philippines and Malaysia. Furthermore, studies on the biology and stocks of some other small pelagic fishes such as the *Decapturnus* spp. or scads, sardines, and anchovies could also be immediately considered for proper management. Mainly harvested for domestic consumption and regional intra-trade, these small pelagic fishes could therefore contribute to food security in the Southeast Asian region.

The South China Sea area is a highly productive body of water in terms of fisheries and marine living resources,

embracing the world's highest level of biodiversity. Khemakorn (2006) cited that the South China Sea is abundant with various marine aquatic species including 1,027 fish, 91 shrimp and 73 cephalopod species in its northern continental shelf; approximately 205 fish and 96 shrimp species in its continental slope; and more than 520 fish species around the islands and reefs of the southern waters. The fishery resources of the South China area are therefore of great importance for local, national and regional exploitations. While the region's fishery resources have been exploited to their maximum level both in marine and inland capture fisheries, changes in fishing activities have occurred not only in the small-scale subsistence fisheries but also in the market-oriented commercial fisheries. Therefore, for the sustainable utilization of the capture fishery resources, the involvement and participation of the peoples in the communities to manage the resources should be enhanced while the promotion of the Ecosystem Approach to Fisheries should be initiated.

Aquaculture Development

During the last three decades when improved aquaculture technologies had just been introduced, production was negligible and aquaculture was then not considered as sunrise or potential industry. However, at the beginning of the 80s when aquaculture production had remarkably increased, currently accounting for about 43% of the total fisheries production of the region, more focus is now being placed on the sustainable development of aquaculture.

The main water areas used for aquaculture comprise mainly the ponds, small lakes, reservoirs, and tidal/coastal areas, while the main species cultured include various fishes, shrimps, mollusks, and aquatic plants in freshwater, brackishwater and marine environments. In recent years, the major species developed for aquaculture included shrimps mainly the tiger and white leg shrimps, *basa* catfish especially in Vietnam, as well as sweet snails, crabs, abalone, and oysters. At the beginning, almost all aquaculture farms in the region had been operated by households in scattered areas using small-scale extensive production methods and semi-intensive farming. Later, intensive production farms had been in operation while farming methods had been improved to respond to the rigid requirements of the export market. This leads to changes in the structure of aquaculture production, which had been guided by scientific-based planning and proper management policies. As aquaculture continued to achieve high economic efficiency and rapid growth rate, changes in terms of economic pattern also occurred. The aquaculture structure has changed from being small-scale and subsistence which highly depends on natural resources and local labor forces, to being intensified and

large-scale production operations which could supply the increasing demand for food fish not only by domestic consumers but also the export markets. Subsequently, aquaculture continued to enhance job creation and income generation, leading to the reduction of poverty especially in the rural areas. However, many factors should be considered in order to achieve sustainable aquaculture development in the region, *i.e.* careful water surface area planning, infrastructure construction and improvement, and proper selection of seeds for culture and production. The development of aquafeeds that requires balancing the supply of fish meal and fish oil from capture fisheries with plant-based raw materials should be revisited. Nonetheless, sustainable aquaculture development could provide one of the most important solutions in balancing the demand and supply of food fish in the coming years.

Production from inland aquaculture and aquaculture-based fisheries which is expected to increase could boost the contribution of aquaculture to food security in the region, while production from brackishwater aquaculture and mariculture is also expected to gradually increase. Therefore, the need to reduce the utilization of fish meal from capture fisheries through the use of alternative sources of protein for the development of new aquafeeds should be considered for the sustainable development of the whole fisheries sector. Meanwhile, aquaculture-based sea ranching could also be promoted as it plays an important role in enhancing both the demersal and small pelagic fishery resources. Moreover, the creation of intensive zone for high-value fish culture, application of standards for safe and sanitary food production in aquaculture zones, intensified protection of the ecosystem and biodiversity, and readjustment of the fisheries structure, should be put forward for sustainable economic development and food security.

Fish Processing and Post-harvest Technologies

The advancement of fish processing and post-harvest technologies to meet the demand for high-value commodities by the export markets had been a major breakthrough in the fisheries sector. In the past, processing of fish such as salting, drying, fermenting, and fish sauce making, made use of traditional methods which are simple economic activities in many countries of the region.

While most of the fishery products before were mainly sold in local markets and meant for domestic consumption, in the early 80s the demand for frozen fish for export grew quickly leading to the massive construction of infrastructures such as cold storage with corresponding increased freezing capacity, and eventually the number of fisheries enterprises increased rapidly. The main

markets for the region's fish and fishery products had increased including the US, Europe, Japan, and some Asian countries. As the markets are diversified in nature, adaptations to meet the market demands for high export value commodities and the accompanying requirements had been considered. The changing structure of commodities and the expansion of markets require that countries should overcome barriers to trade such as regulations on quality standards of fish and fishery products, and anti-dumping policies of the large markets. While the fast changing structure in food processing focused mainly on quality standards, technologies for value-added products were also established. Therefore, fish processing and post-harvest technologies should be given more emphasis to enhance the initial value of the natural aquatic resources in terms of quality as well as increase the volume of value-added products to serve the high-end market and the consuming public. However, such expansion should take into consideration the fisheries structure of the region. As the potentials from capture fishery resources are expected to gradually diminish, post-harvest losses onboard fishing boats and onshore should be reduced.

Management of Major Fishing Areas of Southeast Asia

For suitable fisheries management arrangements, the vast fishery resources of the Southeast Asian region could be divided into main sub-areas (Ekmaharaj *et al.*, 2009) where two or more countries could be covered in the areas including one for inland fisheries (**Box 2**). Additionally, the establishment of sub-areas for the whole South China Sea could facilitate the sustainable management of fishery resources, considering that the level of harvesting, types of resources and fishing methods and practices in the whole South China Sea are known to be varied requiring different ways and means of managing the existing stocks. Since most of problems occurring in each sub-regional area are quite homogeneous, such as depleted demersal resources, *e.g.* in the Gulf of Thailand due to excess fishing capacity and heavy exploitation by trawlers, while the proposed sub-areas are bordered by two or more countries, dialogues between and among countries with similar culture and fishing practices could be easily conducted with agreements which could be more conveniently reached. Moreover, there is an impending need to curtail the decreasing catch of some small pelagic shared stocks, *i.e.* mackerels, *Decapterus* spp., and scads due to the heavy exploitation of the spawners during the spawning season, and that there is also a need to suppress the declining tuna stocks, *i.e.* yellowfin and bigeye in Sulu Sea, and to combat IUU fishing by the local and foreign vessels operating in the Sulawesi Sea, Southern and Southeastern South China Sea

and Arafura Sea. Since the South China Sea covers many large marine ecosystems (LMEs), proper development and management of the resources could be facilitated and could be done by sub-dividing the area into four sub-areas, namely: Gulf of Thailand, Gulf of Tonkin, Sulu-Sulawesi Seas, and Arafura Sea, where relevant issues could be effectively addressed when the cooperation of the countries bordering the sub-areas is enhanced.

In the LMRB which is the most important sub-area for inland capture fisheries, development and management plans could be collaboratively developed, discussed and agreed upon by respective member and riparian countries, taking into consideration the fact that development and management within the country's territory would follow their respective national plans for inland capture fisheries. Since from the regional point of view, most of the inland fishery resources in the LMRB had been fully exploited, measures to sustain its fishery production should be developed. Moreover, Myanmar is expected to sustain its production from inland capture fisheries because of its policy in leasing natural water bodies, *i.e.* lakes, ponds, and flood plains to the public, where recipients of licenses for lease-fisheries are responsible for the conduct of restocking program in the water bodies involved, and could exploit the resources until the fishing season is over.

A similar scheme is also practiced in Thailand under its Village Fishpond Program, where the Department of Fisheries provides the seeds for restocking in village ponds. This program, which aims to sustain food fish security in the rural areas, promotes the involvement of communities in managing the ponds and harvesting the fish from the ponds. The experiences of Myanmar and Thailand could be adapted to the other Southeast Asian countries by initiating programs that aim to propagate indigenous fish species for restocking in natural inland water bodies to enhance the stocks which might have been heavily harvested and thus, protect the environment and ecosystem. In this case, aquaculture-based and restocking programs could be options for the sustainable development and management of inland capture fisheries.

Lessons learned among the countries in the sub-areas especially the ways and means of developing and managing the fishery resources could be exchanged and disseminated to other sub-areas. However, management of fishery resources in some sub-areas, such as the LMRB could be facilitated in collaboration with the Mekong River Commission (MRC) and management of some shared pelagic stocks in the Andaman Sea could be pursued in collaboration with the Bay of Bengal Large Marine Ecosystem (BOBLME) Project.

Box 2. Proposed sustainable development and management of major fishing grounds of Southeast Asia

Lower Mekong River Basin (LMRB). The Mekong River is one of the world's most important rivers in terms of aquatic biodiversity providing fisheries production of 2.5-3.0 million mt/year to the LMRB. Fish and fishery products from this water system are very important for domestic consumption, livelihood and intra-regional trade of the countries bordering LMRB. Management of the fishery resources in the LMRB is carried out through the Mekong River Commission (MRC) Agreement, signed by the bordering countries, *i.e.* Cambodia, Lao PDR, Thailand and Vietnam while Myanmar and China are considered as dialogue partners. The LMRB is mainly a flood plain area where riverine fisheries using multi-fishing gears are practiced with the high involvement of farmers and rural people. The major threat for the sustainable development of the fishery resources in the LMRB is not mainly from fishing operations but more from the massive construction of dams and reservoirs along the Mekong River. Another critical issue related to the reproduction of fish in the LMRB is the seasonal changes of the monsoon and flooding patterns, and fish migration paths as well as development of proper fish broodstock management during the dry season. These concerns should be addressed for the sustainable development of the LMRB.

Andaman Sea. Part of East Indian Ocean and bordered by the Andaman and Nicobar Islands, the Andaman Sea is situated between those islands and the Malay Peninsula, and is also semi-enclosed. The geographical and bottom features include large continental shelf in the northern part, especially in the coastal area of Myanmar which comprises deep and very deep basin down to 2000 meters in the central part. As one of the important Large Marine Ecosystems (LMEs), some small pelagic fish stocks are shared by the countries bordering the Andaman Sea, *i.e.* the hilsa (*Tenulosa ilisha*) stocks shared by Myanmar and Bangladesh, and the *Rastrelliger* spp. stocks shared by Thailand, Myanmar and Malaysia. The fishery resources in the Andaman Sea had been considered abundant especially in its continental slope, and in the Irrawaddy delta down to depths of 150-300 meters, where large pelagic species such as the yellowfin and bigeye tunas are known to inhabit. The monsoon pattern is a key seasonal change that benefits efforts to conserve the fish stocks in the area because during such season it would be risky to operate any fishing activity. This resulted in reduced exploitation of the fishery resources allowing the fish stocks to recover. In spite of attempts to conduct exploratory fishing operations in the area from time to time, the potentials and status of the economically-important fish stocks are still not fully known. Nevertheless, the coastal and continental shelf stocks have been reported to be almost fully exploited, in which case close monitoring of the fisheries is deemed necessary and proper management measures should be established to ensure the long-term sustainability of the fishery resources in the Andaman Sea.

South China Sea (SCS). One the most important fishing areas in the region, the whole South China Sea is bordered by nine coastal states, namely: Brunei Darussalam, Cambodia, China, Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam. It is considered an LME but with specific characteristics in terms of its oceanographic conditions, biology and ecology. The SCS is also a semi-enclosed sea that covers an area of around 3.5 million km² of the Pacific Ocean. The major gulfs and bays include the Gulf of Thailand, Gulf of Tonkin (Vietnam), and the Lingayen Gulf and Manila Bay of the Philippines. The extensive continental shelves, relatively shallow depths, and influx of numerous rivers, make the SCS a highly productive area in terms of fisheries and other marine living resources. In addition, the mangrove forests, sea grass beds, coral reefs and soft-bottom community habitats that abound the SCS are highly productive ecosystems, making the fishery resources of the area of great importance for food security and income generation, not only locally and nationally but also regionally and internationally. As recorded, the South China Sea produces about 10 million mt of fish every year accounting for more than 70% of the region's total fish production and about 7% of the world's total fisheries production. However, the fishery resources in South China Sea could be heavily exploited from the persistent use of destructive fishing gears and practices, especially dynamite fishing, cyanide fishing and the use of very small mesh size nets. Therefore, the possibility of increasing fish production could still be there, despite the difficulties posed during fishing operations in the area due to conflicts among countries bordering the SCS and among fishers.

Gulf of Thailand Sub-area: Once considered one of the most fertile and highly potential fishery areas of the SCS, the Gulf of Thailand (GOT) is bordered by Thailand, Cambodia, Vietnam, Malaysia, and Indonesia, and embraces a topographic feature which includes shallow bottom making it a large basin of less than 80 meters deep. Many rivers bring nutrients to GOT contributing to its diversified fishery resources but making coastal small-scale and offshore commercial fishing operations complicated. The major fisheries focus on various demersal species, shellfishes and many small pelagic species such as the Indo-Pacific mackerel, round scads and Spanish mackerel. At present, the demersal fishery resources in the Gulf are overexploited and depleted due to inadequate effective management measures, more particularly overcapacity fishing practices which put high pressure on the resources. While in 1970s, the catch per unit of effort (CPUE) was more than 350 kg/hour, in 2010 it had gone down to about 20-30 kg/hour. The dwindling demersal fishery resources led to reduced livelihood opportunities which also resulted in conflicts between small-scale and commercial fishers.

Gulf of Tonkin Sub-area: Situated in the waters of Vietnam northwest of the South China Sea, the Gulf of Tonkin possesses a geographic feature which is similar to the Gulf of Thailand, which is shallow and is also a large basin. The fishery resources of the Gulf had been depleted due to the high pressure from intensive fishing operations carried out by fishers from Vietnam and China. Nevertheless, conflicts and opportunities among these two countries' fishers are discussed and agreements reached from time to time during dialogues between Vietnam and China.

Sulu-Sulawesi Seas Sub-area: This huge area comprises many inter-connected seas such as the Sulu and Sulawesi Seas (SSS) which also encompasses the Banda Sea, Molucca Sea, Flores Sea and Celebes Sea areas, as well as the Southern and Southeastern South China Sea. SSS embraces great biodiversity in terms of coastal and offshore resources, and is a very important habitat for tuna species. Its geographic feature includes over 80% deep areas with depths ranging from 200 to 5000 meters, and a number of small islands which are important habitats for sea turtles and are known breeding and spawning grounds of yellowfin and bigeye tunas. The demersal fishery resources are believed to be underexploited because the coastal areas are not suitable for trawling, providing great opportunity for sustainable utilization of such resources. However, this area also experiences high pressure from fishing activities for its small pelagic fishery resources and tuna resources by purse seines and ring nets, and the area has been most strategic for illegal, unreported and unregulated (IUU) fishing in the region especially with the presence of fishing vessels coming from within and outside the region. Purse seine fisheries using payaw as fish aggregating device (FAD), are believed to have resulted in the reduction of the tuna juveniles affecting the tuna stocks. Therefore, there is a need for the countries bordering the area such as Malaysia, Philippines and Indonesia, to enhance their cooperation and come up with joint management approaches for the straddling and highly migratory fish stocks in the SSS.

Arafura Sea Sub-area: The Arafura Sea is connected to the Timor Leste Sea, Papua New Guinea (PNG) Sea and western Australian Sea, and is a significant area for tuna fisheries. The local fishers in the coastal area are still using traditional fishing practices to harvest tunas while many purse seine fishing vessels are operating in the offshore area. Arafura Sea could be another major area for IUU fishing by foreign vessels especially that the tuna resources in this area are still abundant.

Box 3. International, regional instruments and arrangements that play very important roles in dealing with the crisis in fisheries

<p>United Nations Convention on the Law of the Sea. The 1982 UN Convention on the Law of the Sea (UNCLOS) set forth legal frameworks for marine fisheries and environmental protection through the establishment of exclusive economic zones (EEZs). Coastal states exercise sovereign rights for exploiting, conserving and managing the natural resources of their respective EEZs.</p>
<p>Agreement for the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. The 1995 Agreement is the primary mechanism for international cooperation in conserving and managing the straddling and highly migratory fish stocks.</p>
<p>Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas. The 1993 Agreement has been seen as a significant international instrument for fisheries management in the South China Sea area and for settling various territorial disputes, considering that SCS contains a maritime area considered as high seas.</p>
<p>Code of Conduct for Responsible Fisheries (CCRF). Adopted in 1995, the CCRF has been promoted in the Southeast Asian region through the SEAFDEC project on the Regionalization of the Code of Conduct for Responsible Fisheries. The project was aimed at addressing concerns in the implementation of the CCRF at national level, and clarifying provisions of the CCRF that are critical to the region's fisheries development and management.</p>
<p>FAO International Plans of Action. FAO has promoted the development of International Plans of Action (IPOAs) in order to address specific key issues in the 1995 CCRF as the implementation of the CCRF would be greatly reinforced through the development and promotion of sets of voluntary IPOAs. Thus, IPOAs had been promoted to address specific issues, such as: IPOA for Reducing Incidental Catch of Seabirds; IPOA for the Conservation and Management of Sharks; IPOA for the Management of Fishing Capacity; and IPOA to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA on IUU Fishing).</p>
<p>Regional Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated (IUU) Fishing. With regards to the IPOA on IUU Fishing, the development of the Regional Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (RPOA-IUU Fishing) was initiated by Indonesia and Australia in 2007. The RPOA-IUU Fishing had since then been adopted by the countries in the Southeast Asian region for the sustainable management of their respective fisheries.</p>

Moreover, the South China Sea is also known to embrace areas that encompass non-living natural resources, such as oil and gas resources that made Indonesia one of the world's leading oil exporting countries, and combination of onshore and offshore petroleum resources that provide Brunei Darussalam with the highest per capita gross national production in the region. Nevertheless, the extent of hydrocarbon resource deposits remains unclear, because of the absence of full exploration particularly in the Spratly Islands which comprise the biggest group of islands in the SCS. It is presumed that such situation encouraged many countries in the region to claim territorial rights over the islands in the SCS for possible extraction of the hydrocarbon resources.

Considering that small pelagic fish stocks such as mackerel, scads and highly migratory fish stocks such as tuna and tuna like fishes, are shared by two or more countries bordering the South China Sea, joint development and management schemes for these fish stocks should be established and adopted, especially that these straddling stocks had been reported to have reached their maximum sustainable yield. The tuna stocks of the SCS which are exploited through long line, purse seine, pole-and-line, and live-bait fisheries, are presently not yet overexploited. Nonetheless, many developing countries have expressed interests in tuna fisheries as potential source of foreign currency, and in most cases such fisheries are offshore operations where countries bordering the SCS have to compete with distant water fishing countries for harvesting the stocks. In spite of the lower labor costs of the countries bordering the SCS, increased fuel costs hinder these countries to sustainably harvest the tuna stocks. Meanwhile, it is also almost certain

that extension of fishery jurisdictions resulting from the eventual resolution of the region's boundary issues could restrict fishing operations in the SCS by non-South China Sea states. Under such circumstance, the skipjack tuna resources could be largely available only in the internal waters of Indonesia and the Philippines.

Legal instruments are also key elements for the successful development and management of fisheries. Since the beginning of the 2000s, the crisis experienced by the fisheries sector had become more serious even if the total production trend continued to increase. While the structure of fisheries has changed, the marine capture fisheries subsector is on the verge of collapse, and could eventually create a domino effect for the other fishery sub-sectors to also collapse. Thus, it is imperative that the situation should be carefully handled through multi-disciplinary actions taking into consideration the various instruments and agreements (**Box 3**), and sustain the whole fisheries sector.

Conclusion

The waters of Southeast Asia, which comprises two main LMEs located in the Andaman Sea and South China Sea, possess unique oceanographic, biographic and ecological characteristics and abundant fishery resources with potentials for increased economic growth. These LMEs are also known to encompass large deposits of hydrocarbons fueling continued disputes among countries within and outside the region. The undefined maritime boundary and territorial disputes among the coastal countries of the South China Sea have also seriously undermined the peaceful and optimum utilization of the fishery resources in this area.

Notwithstanding its important role in attaining food security and enhancing the economies of majority of the countries in the region, fisheries should be developed and managed sustainably. While demersal resources of most countries are fully exploited or even overexploited, the integration of rights-based fisheries management with the Ecosystem Approach to Fisheries (EAF) is a promising measure for the sustainable coastal resources management. Together with resource enhancement through restocking of indigenous fish species, sea ranching of endangered species should also be encouraged. The establishment of sub-areas in the LMEs for the sustainable management of both small and large pelagic fish species such as scads and mackerels, and tunas, should be considered. Similarly, the EAF approach could also be applied as means for the management of offshore and high sea fisheries especially in the South China Sea and Andaman Sea. Meanwhile, enhanced cooperation especially in undertaking joint development and management programs such as the establishment of *refugias* in critical fishing grounds of the countries' EEZs as well as in preventing, deterring and eliminating IUU fishing by both domestic and foreign fishing vessels should be promoted. Traditionally, inshore fishing grounds are *open access* areas and as a result, these resources had been overexploited. Unless appropriate property rights are established, it will be extremely difficult to control and rationalize the access to such fishery resources. Empowering the communities along the coastlines to take up the monitoring, control and surveillance of the resources should therefore be enhanced. Management measures for small pelagic and highly migratory pelagic species should be discussed and agreed upon among concerned countries in each sub-area, *i.e.* for mackerel, scads, sardines, hilsa and tunas in the Gulf of Thailand, Gulf of Tonkin, Andaman Sea and Sulu-Sulawesi Seas, while fish *refugias* mainly for small pelagic species should be established in critical fishing grounds. Measures to combat IUU fishing in the Sulu-Sulawesi Seas, Eastern and Southeastern South China Sea and Arafura Sea should be strengthened. Regulations to control the catching of juveniles of the yellowfin and bigeye tunas should be established through collaborative arrangements among concerned countries. For the management of inland capture fisheries, restocking program for the aquaculture-based and village fishponds could be undertaken to supply the food fish required for domestic consumption. While aquaculture development has progressed tremendously during the past decade, the culture of food fish for direct consumption has slowed down which could be due to decreasing production from capture fisheries which serves as raw materials for fish meal and fish oil as ingredients for aquafeeds. Therefore, in order to sustain the aquaculture production of the region, culture of herbivorous fish species should be encouraged and

promoted. As a technical fisheries body, SEAFDEC plays very important role in providing technical inputs and fora in finding ways and means for the sustainable development and management of fisheries in the region. In the absence of a Regional Fisheries Management Body in the region, cooperation among the countries is necessary for the implementation of the management measures and policies, which should be supported by regional bodies, *i.e.* the ASEAN Sectoral Working Group on Fisheries (ASWGF). In summary, since the region's fisheries continue to be on the brink of collapse, precautionary approaches should be considered and adopted for the sustainability of the fisheries sector of Southeast Asia.

References

- Ekmarahaj, Siri, Magnus Torell and Somboon Siriraksophon. 2009. Towards Sustainable Fisheries and Aquaculture in Southeast Asia: A Call for the Development of Regional Fisheries Management Strategies. *In*: Fish for the People, Vol. 7 No. 1 (2009). Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 3-10
- Khemakorn, Pukjuta. 2006. Sustainable Management of Pelagic Fisheries in the South China Sea Region. Technical Paper submitted to the United Nations-the Nippon Foundation of Japan Fellowship, UN, New York City, November 2006; 86 p
- Lymer, D., Funge-Smith, S. and Miao, W. 2010. Status and Potential of Fisheries and Aquaculture in Asia and the Pacific 2010. RAP Publication 2010/17. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand; 100 p
- Pongsri, Chumnarn. 2010. Boosting the Contribution of Fisheries to ASEAN Food Security Towards 2020. *In*: Fish for the People, Vol. 8 No. 2 (2010). Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 5-10
- SEAFDEC. 2010. Fishery Statistical Bulletin of Southeast Asia 2008. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 135 p
- SEAFDEC. 2011. Fishery Statistical Bulletin of Southeast Asia 2009. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 149 p
- SEAFDEC. 2012. The Southeast Asian State of Fisheries and Aquaculture 2012. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 130 p

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Trending Fisheries Development in Southeast Asia towards Poverty Alleviation

V.T. Sulit

Perceiving from the region's fishery statistics only, it is easily recognizable that the trend of fisheries production of Southeast Asia appears to be increasing over the last two or more decades. This does not mean that fisheries production of each country may be increasing as there could be increases in some while decreases could have also taken place in other countries. However, there is no reason why such trend would not continue to increase in the future, as could be generally attributable to improvements in fisheries management and adoption of good and responsible practices by concerned stakeholders in the region. Nonetheless, such increasing trend must fully accord with the ever increasing population of Southeast Asia to enable the fisheries sector to provide the nutrition and protein requirements of the region's populace and alleviate poverty especially in the remote rural areas.

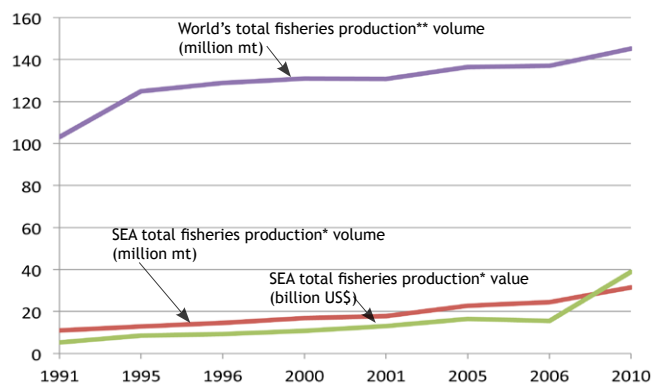


Fig. 1. Total fisheries production of Southeast Asia from 1991 to 2010 (by five-year period)

* Fishery Statistical Bulletin for the South China Sea Area 2000-2007 (SEAFDEC, 2010) and Fishery Statistical Bulletin of Southeast Asia (SEAFDEC, 2010-2012)
 ** FAO FishStat Plus and State of the World Fisheries and Aquaculture 2004 and 2010

During the past two decades, fisheries production of the Southeast Asian countries had been slowly but gradually rising at an average annual rate of about 3.7% in terms of volume and about 6.0% in terms of value (Fig. 1). However, it is feared that such minimal annual increase might not be able to sufficiently provide the socio-economic needs of the increasing millions of people in the region who are dependent on the fisheries sector for food and livelihood. In an effort to address such concern, the Southeast Asian countries have been adopting various measures to sustain production from fisheries as well as from aquaculture, not only through management of fishing efforts and adoption of good and responsible practices but also in improving fisheries management that integrates the social, economic

and environmental aspects in what is known as the ecosystem approach to fisheries management.

With the region's population growth which is forever on the rise (Table 1), the countries are therefore putting more focus in improving fisheries management that could maximize the benefits to the rural poor, by mainly addressing the needs and requirements of stakeholders in the fisheries and aquaculture sector as well as other supporting sectors that also play major role in providing livelihood and employment opportunities in rural communities. With technical assistance provided by the Southeast Asian Fisheries Development Center (SEAFDEC), the Southeast Asian countries are now implementing fisheries

Table 1. Population of the Southeast Asian countries with projections for 2025 and 2050 (millions)

Countries	2008	2009	2010	Mid-2011	Mid-2025	Mid-2050
Brunei Darussalam	0.4	0.5	0.4	0.4	0.5	0.6
Cambodia	14.7	14.8	15.1	14.7	19.0	23.8
Indonesia	239.9	240.3	235.5	238.2	273.2	309.4
Lao PDR	5.9	6.3	6.4	6.3	8.3	10.7
Malaysia	27.7	28.3	28.9	28.9	34.9	41.0
Myanmar	49.2	50.0	53.4	54.0	61.7	70.8
Philippines	90.5	92.0	94.0	95.7	117.6	140.5
Singapore	4.8	5.0	5.1	5.2	5.7	5.5
Thailand	66.1	65.0	68.1	69.5	72.6	73.4
Vietnam	86.2	88.1	88.9	87.9	103.2	113.7
Total	585.4	590.3	595.8	600.8	696.7	789.4

Source: World Population Data Sheet 2009, 2010; Population Reference Bureau, Washington D.C., U.S.A.

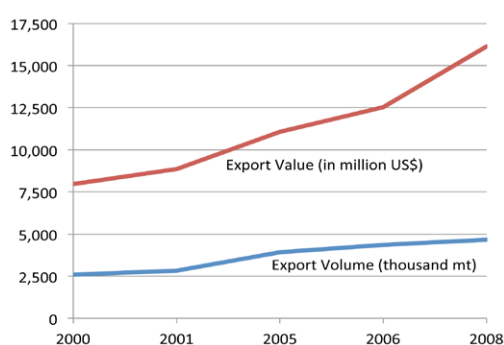


Fig. 2. Export of fish and fishery products by Southeast Asian countries

Sources: *Fishery Statistical Bulletin for the South China Sea Area 2000-2007* (SEAFDEC, 2010a) and *Fishery Statistical Bulletin of Southeast Asia 2008* (SEAFDEC, 2010b)

development programs that are focused towards improving rural livelihoods with the ultimate goal of alleviating poverty in the rural communities.

Where does the fish catch of Southeast Asian countries go?

In Southeast Asia, the fisheries sector has been playing a vital role in providing sufficient supply of fish to the people and in improving the economies of the countries in Southeast Asia. The region's fish catch is sold either as fresh or frozen or in comminuted form or other value-added products such as cured and fermented fish products. A major portion of the fish and fishery products is also exported (Fig. 2) to fish supply deficit countries while still another considerable portion is converted into animal feeds.

From the region's total fisheries production in 2010 of 31.4 million mt, a maximum of about 14 million mt is processed into traditional fish products based on the claims

of Yeap and Tan (2002) that 30-45% of the region's annual fisheries production is destined to be processed and value-added into traditional and surimi-based fishery products. Meanwhile, FAO (2012) argued that about 13.6% of the world's total fisheries production had been converted into non-food uses such as fish meal and fish oil or as direct feeds in aquaculture. Granting that these assumptions are still valid, the region's fisheries production in 2010 is left with only about 13.0 million mt for domestic consumption of its people and for export to other countries in the region and outside. Therefore, the more affluent countries of the region have to import fish from other countries in order to address the increasing demand for fish and fishery products (Table 2). Where will the less prosperous countries get sufficient supply of fish to feed their people?

The peoples of Southeast Asia are by nature fish-eating, and due to enhanced economic development of many countries major portions of the populace can afford to buy fish. This would increase not only the region's demand for fish but also possibly increasing the per capita fish consumption. With the region's average per capita consumption at a high of about 39 kg/person/year (Table 3), it is likely that the region would consume about 65% of the total supply of fish and fishery products available in the region, i.e. from production plus importations. Many countries are also trying to balance the volume of fish for consumption with those for export, and also improving their respective systems of collecting fisheries information especially from small-scale fisheries and inland capture fisheries to ensure that the written assumptions conform to the picture of the real situation. The inadequate information on the region's fisheries production exacerbates all efforts in presenting the clear and actual situation of the fisheries sector of the region.

Table 2. Import of fish and fishery products by Southeast Asian countries in 2007 (Volume in thousand mt; Value in million US\$)

Countries	2000		2001		2005		2006		2008	
	Volume	Value	Volume	Value	Volume	Value	Volume	Value	Volume	Value
Brunei Darussalam	6.6	15.2	8.3	13.4	6.4	15.8	7.7	25.7	4.9	12.3
Cambodia	3.2	2.7	1.1	0.5	3.1	3.7	3.1	4.3	2.2	2.4
Indonesia	171.3	101.6	152.0	93.7	128.4	106.3	165.2	142.7	199.0	202.0
Lao PDR	2.5	2.1	3.1	2.2	3.6	3.3	3.0	3.1	3.9	4.4
Malaysia	323.2	307.5	349.3	335.2	399.4	533.9	435.6	587.0	383.3	591.6
Myanmar	1.5	1.9	0.6	0.6	1.9	3.2	1.4	2.6	2.4	5.2
Philippines	248.4	111.6	181.0	71.4	182.8	102.8	179.6	101.1	210.2	176.6
Singapore	183.9	560.4	174.4	494.4	253.6	776.6	244.7	757.6	225.7	916.1
Thailand	813.8	826.7	977.7	1,072.9	1,445.4	1,457.9	1,470.6	1,574.0	1,533.7	2,447.8
Vietnam	8.0	36.2	42.5	60.2	165.6	276.6	200.7	302.4	253.3	461.1
Total	1,762.4	1,965.9	1,890.0	2,144.5	2,590.2	3,280.1	2,711.6	3,500.5	2,818.6	4,819.5

Sources: *Fishery Statistical Bulletin for the South China Sea Area* (SEAFDEC, 2000-2009) and *Fishery Statistical Bulletin of Southeast Asia* (SEAFDEC, 2010)

Table 3. Fish consumption of the Southeast Asian countries in 2009 and 2010

Countries	Fisheries Production (thousand mt) ¹			Population (millions) ²			Fish Consumption ³ kg/person/year (2007)
	2008	2009	2010	2008	2009	2010	
Brunei Darussalam	2.7	2.4	2.8	0.4	0.5	0.4	44.04
Cambodia	536.3	515.0	550.0	14.7	14.8	15.1	32.97
Indonesia	9,054.9	10,064.1	11,662.3	239.9	240.3	235.5	31.43
Lao PDR	93.5	105.0	113.0	5.9	6.3	6.4	24.86
Malaysia	1,639.0	1,729.0	1,806.6	27.7	28.3	28.9	54.40
Myanmar	3,147.6	3,491.1	3,902.0	49.2	50.0	53.4	42.75
Philippines	4,964.7	5,084.7	5,155.6	90.5	92.0	94.0	53.49
Singapore	5.2	5.7	5.2	4.8	5.0	5.1	23.00 ⁴
Thailand	3,204.2	3,137.7	3,113.3	66.1	65.0	68.1	37.97
Vietnam	4,559.7	4,782.4	5,127.6	86.2	88.1	88.9	41.47
Total	27,207.8	28,917.1	31,438.4	585.4	590.3	595.8	Ave: 38.64

Sources: Fishery Statistical Bulletin for the South China Sea Area (SEAFDEC, 2000-2009) and Fishery Statistical Bulletin of Southeast Asia (SEAFDEC, 2010)

How are the major concerns in Southeast Asian fisheries being addressed?

In the given scenario of the region's fisheries, there appears to be no more fish left for export that could have improved the economies of the countries and enhanced the socio-economic well-being of the fishers. In addition, there is also no more fish left that could be transformed into value-added fish products that could have supplemented the incomes of women and children in rural communities. Where would this group of people go?

Assuming further that there are about 15 million small-scale fishers in Southeast Asia, and granting that for every fisher household there are other 2-4 fish workers, *i.e.* spouse and young children working in ancillary activities, this would mean a total of about 45 million fish workers in the region. Taking into account the trend of the region's fish export data (Fig. 2) which had been increasing at the rate of 16.03% per year, and considering the lower range of such trend, it can be predicted that the export value in 2010 could have reached the minimum of US\$21,719.4 million. This implies that each fish worker must have earned at most US\$480.0 per year or a minimum of US\$1.30/day from the fish they caught and exported. This amount is just some cents above the lower limit of US\$1.25 poverty threshold but much lower than the upper limit of US\$2.50 poverty line (Chen and Ravallion, 2010). Therefore, there is nowhere for these groups of people can go in order to augment their incomes. So, they will have to remain the most marginalized groups

of society, while continue muddling in severe poverty. These are the groups that need assistance in order that they would be able to extricate themselves out from poverty. Therefore, governments should consider redirecting their objectives of national fisheries development towards alleviating poverty especially in remote rural fishing communities.

Initiatives of Southeast Asian Countries

The countries in Southeast Asia have not been short of developing approaches and strategies that aim to alleviate poverty for the benefit of their respective rural fishing communities. In the CLMV countries for example, the Royal Kingdom of Cambodia has developed its Millennium Development Goals which include the need to eradicate extreme poverty and hunger in the country through a rectangular strategy, the first and foremost rectangle of which focused on enhancing the agriculture sector through reforms in the fisheries sector (FiA, 2008). Lao PDR has also been exerting efforts to reduce poverty in the country which mainly aim to liberate Lao PDR from the group of the world's Least Developed Countries by 2020 through sustainable and equitable development especially in its inland fisheries sector (Sirimanotham and Norachack, 2008). Myanmar has also developed strategies for the improvement of the country's fisheries production which include the objective of upgrading the socio-economic status of its fisheries communities including fish farmers, through the adoption of responsible fishing and good aquaculture practices, as well as the generally-accepted food safety policies. However, the country needs technical and financial support for such endeavors (Kywe and Than, 2008). The Comprehensive Poverty Reduction and Growth Strategy (CPRGS) of Vietnam had been promoted

¹ Source: Fishery Statistical Bulletin of Southeast Asia 2010 (SEAFDEC, 2012)

² Sources: World Population Data Sheet 2009, 2010; Population Reference Bureau, Washington D.C., U.S.A.

³ Sources: Fishery Statistical Bulletin for the South China Sea Area (SEAFDEC, 2010) and Fishery Statistical Bulletin of Southeast Asia (SEAFDEC, 2011)

⁴ Source: Agri-Food & Veterinary Authority of Singapore

in the country since 2002. The CPRGS takes advantage of fisheries and aquaculture as the major players in the country's national poverty reduction program from 2010 and beyond (Dao and Nhung, 2008).

The Philippines promotes poverty alleviation through people and resource development in accordance with the country's Fisheries Code of 1998 and Local Government Code of 1991, which had been used to establish the National Anti-Poverty Alleviation Commission (NAPC). Specifically for the country's fisheries sector, the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) closely partners with the people's organizations, *e.g.* a broadcast alliance of fisherfolk organizations of the country known as *Pampano (Pambansang Alyansa and mga Mangingisda at Pamunuan ng Organisasyon)*, as well as with the collaboration of the Fisheries and Aquatic Resources Management Council (FARMC), a consultative and recommendation body for policy formulation at the local and national levels (Domenden and Capricho, 2008).

Initiatives of SEAFDEC

The assumptions used in this paper are not intended to invite any external interventions considering that these are based mainly on the available fishery statistics that had been compiled by SEAFDEC based on inputs from the Southeast Asian countries. However, these are meant to construct a picture of the actual situation of the fisheries communities in the region to assist SEAFDEC in formulating activities that aim to address the socio-economic concerns in fishing communities. Nonetheless, one has to go to the fishing communities to see how fishers are surviving through difficult times. While also recognizing that fishers are "not passive" beneficiaries of interventions but are in fact the "drivers of change" as stressed by Arthur and Sheriff (2008), SEAFDEC had focused its attention to the well-being of the fishers when it implemented two ASEAN Foundation funded projects in 2008-2010 that aim to alleviate poverty in rural fishing communities.

The Promotion of "One Village, One Fisheries Product (FOVOP)" System to Improve the Livelihood of the Fisheries Communities in the ASEAN Region has been carried out in the Southeast Asian countries through the conduct of human resource development activities as a strategy for improving the rural fisheries livelihoods. The approach developed through the FOVOP Project which is laid out in details in the Regional Guidelines for the Promotion of FOVOP in the ASEAN Region, is meant as guide for government agencies in providing support to rural fishing communities in order that their livelihoods are improved and thereby alleviating poverty (Wongsanga and Sulit, 2010; and Wongsanga and Vichitlekarn, 2010).

Moreover, while acknowledging that poverty eradication in rural fishing communities of the region could be effectively advocated by enhancing the capacity of stakeholders in fisheries, SEAFDEC also implemented the Project on Human Resources Development (HRD) for Poverty Alleviation and Food Security by Fisheries Intervention in the ASEAN Region. It was envisioned that through the HRD Project, poverty in fishing communities could be alleviated by enhancing human capacity at the community level using the technical expertise of SEAFDEC as tools in enhancing their skills in fisheries and aquaculture in order to increase fisheries production in a sustainable way. The regional policy recommendations developed through the HRD Project had been promoted to serve as guide for the governments in mainstreaming poverty alleviation and food security by fisheries intervention in their respective national policies (Kankamnerd, 2010).

In a more long-lasting manner, SEAFDEC also supports the efforts of the ASEAN to combat Illegal, Unreported and Unregulated (IUU) Fishing and the Indonesia-based Regional Plan of Action (RPOA) to Promote Responsible Fishing including Combating IUU Fishing, as means of attaining food security and alleviating poverty in the Southeast Asian region (Poernomo *et al.*, 2011). As the technical arm of the ASEAN, SEAFDEC has been conducting consultations with core experts in the region to develop a regional registration of fishing vessels as this could serve as crucial tool for combating IUU fishing in the region and eventually, alleviate poverty in fishing communities. In addition, guidelines that would aim to prohibit the trading of IUU products from the region would also be developed through a series of consultations. Meanwhile, training courses are conducted at SEAFDEC Training Department in Samut Prakan, Thailand to promote the importance and relevance of IUU Fishing Related Countermeasures in the Southeast Asian countries.

Through its Philippine-based Aquaculture Department (AQD), SEAFDEC has been promoting sustainable aquaculture development in rural areas as means of enhancing rural livelihoods. This is in response to the countries' call for the advancement of good aquaculture practices in rural communities as a strategy for addressing food security and combating poverty in the region. Thus, AQD has been providing technical support to the countries through the conduct of on-site training sessions in selected countries on responsible aquaculture technologies that are technologically feasible and safe, socio-economically viable, and environment-friendly (Toledo *et al.*, 2011). Furthermore, while recognizing the crucial role of fisheries post-harvest technology in the sustainable development of fisheries for food security in Southeast Asia, SEAFDEC through its Marine Fisheries Research Department

(MFRD) in Singapore has been conducting human resource development activities that aim to improve the quality of traditional fish products, as well as promote the adoption of quality, safety and control systems in fishery products to ensure that the niche of the region's fishery products in the world market is not taken by other suppliers. In this regard, MFRD has been developing technologies that aim to optimize the utilization of catch, reduce post-harvest losses, improve quality of traditional fish products, and institute measures to comply with international food safety requirements (Yeap and Chung, 2011).

What the future may bring to the well-being of rural fishing communities of Southeast Asia

The integration of fisheries into the ASEAN Economic Community which is expected to be completed by 2015 implies that the ASEAN member states would be transformed into a community with free movement of goods, services, investments, and skilled labor as well as free flow of capital. To be able to take full advantage of the integration, the countries must make sure that the social, economic, environmental, and political concerns in their respective fisheries sector are addressed, and should also attempt to reach a certain level of fisheries development that would be at par with the other countries of the region.

Fisheries development could only be sustainable if the well-being of the fishers and fish workers is taken care of by governments, which means that rural livelihoods are improved and poverty is eradicated in rural fishing communities. The relevant technical aspects of as well as the guidelines and recommendations for poverty alleviation have already been laid out as mentioned earlier. It is now the turn of the governments to mainstream these aspects into their respective national development policies. The aforementioned concepts and assumptions boil down to improving governance and management for sustainable fisheries. In this aspect, it is necessary for governments to take a closer look at their small-scale fisheries in relation to the well-being of fishing communities, and ask the question whether fishing communities are participating in fisheries and environmental management, and promoting effective accountability of the resources (SEAFDEC, 2012b). The answer to such question could form a basis for the development of appropriate policies that could improve the well-being of the fishing communities.

Towards this end and in an effort to pave the way for the countries to attain such objective, the ASEAN and SEAFDEC through the 2011 Resolution would want to make sure that the direction of the region's fisheries development is towards "*sustaining the supply of fish*

and fishery products to improve food security, facilitate poverty alleviation, and improve the livelihoods of ASEAN people dependent on harvesting, farming and marketing of fish and fishery products, by enhancing the necessary national fisheries policy, legal and institutional frameworks that encourages and support small-scale fishers/farmers, including providing alternative livelihood opportunities".

Moreover, in the accompanying 2011 Plan of Action, the countries should develop fisheries programs and activities that aim among others, to "*strengthen the capacity of fisheries communities and the capability of fisheries-related organizations, NGOs and the private sector to better implement necessary actions towards enabling communities and local organizations to increase resilience, improve livelihoods, alleviate poverty, adopt alternative livelihoods, adapt to climate change in support of achieving sustainable development, and encourage the participation of women and youth groups in the process"* (SEAFDEC, 2011). The provisions in the ASEAN-SEAFDEC Resolution and Plan of Action 2011 have been strengthened with the common vision adopted at the Rio+20 United Nations Conference on Sustainable Development in Rio de Janeiro, Brazil on 20-22 June 2012 that recognizes "*the crucial role of healthy marine ecosystems, sustainable fisheries and sustainable aquaculture for food security and nutrition and in providing the livelihoods of millions of people"*.

In the Philippines, a famous folk song "*Si Filemon*" reveals a message on the need to conserve fishery resources since fish catch has become smaller not only in terms of size but also in quantity. As portrayed in the song by *Filemon*, a small-scale local fisher using selective gear, *i.e.* hook-and-line and operating in nearshore area, he could catch only small fish which when sold to local market give him few cents enough to buy "*tuba*" a local wine produced from coconut sap (Diaz and Bañares, 2008), and perhaps nothing more is left for the subsistence of his family. This song must have been composed more than 50 years ago, but it is sad to note that fisheries management authorities seemed not to have taken heed of the message conveyed in the song. Should the many *Filemons* be therefore left alone to fend for themselves and continue to suffer from absolute poverty without expecting any improvements of their situation, because interventions by fisheries authorities are not adequate enough to address the degrading fishery resources, as the song tried to suggest? May be the right time has already come for fisheries agencies to consider trending their fisheries development policies towards poverty alleviation or else many *Filemons* would just disappear from the seas and oceans, and in the end nobody will catch fish to supply the protein requirements of the rest of the people.

References and Other Readings

- Arthur, Robert and Natasja Sheriff. 2008. Fish and the Poor. *In*: Briones, Roehlano M. and Arnulfo G. Garcia (eds). 2008. Poverty Reduction through Sustainable Fisheries: Emerging Policy and Governance Issues in Southeast Asia. Institute of Southeast Asian Studies (ISEAS), Singapore; and SEAMEO Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines; pp 15-37
- Chen, Shaohua and Martin Ravallion. 2010. The developing world is poorer than we thought, but no less successful in the fight against poverty. World Bank Policy Research Paper No. WPS 4703. World Bank, U.S.A.
- Dao Hong Duc and Nguyen Thi Trang Nhung. 2008. National policy relating to poverty alleviation in the fisheries sector of Vietnam. Paper presented during the ASEAN-SEAFDEC Regional Technical Consultation on Fisheries Human Resources Development for Poverty Alleviation, Bangkok, Thailand, 3-5 July 2008; Southeast Asian Fisheries Development Center, Bangkok, Thailand
- Diaz, Gloria C. and Arsenio S. Bañares. 2008. Co-management in Philippines Fisheries: The Fisheries and Aquatic Resources Management Council (FARMC). *In*: Fish for the People, Vol. 6 No. 3 (2008). Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 31-35
- Domenden, Nestor D. and Charles C. Capricho. 2008. The Philippine poverty alleviation strategy. Paper presented during the ASEAN-SEAFDEC Regional Technical Consultation on Fisheries Human Resources Development for Poverty Alleviation, Bangkok, Thailand, 3-5 July 2008; Southeast Asian Fisheries Development Center, Bangkok, Thailand
- FAO. 2012. The State of World Fisheries and Aquaculture 2012. Fisheries and Aquaculture Department, FAO, Rome, Italy; 209 p
- FiA. 2008. Millennium Development Goals of Cambodia: Fisheries Human Resources Development, Fisheries Administration (FiA) of Cambodia. Paper presented during the ASEAN-SEAFDEC Regional Technical Consultation on Fisheries Human Resources Development for Poverty Alleviation, Bangkok, Thailand, 3-5 July 2008; Southeast Asian Fisheries Development Center, Bangkok, Thailand
- Kankamnerd, Jariya. 2010. Mobilizing Regional Expertise to Alleviate Poverty by Fisheries Intervention in Southeast Asia: SEAFDEC Initiatives. *In*: Fish for the People, Vol. 8 No. 3 (2010). Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 15-20
- Kywe, Nilar and Mya Mya Than. 2008. Current status of fisheries and Myanmar and efforts to alleviate poverty in fishing communities. Paper presented during the ASEAN-SEAFDEC Regional Technical Consultation on Fisheries Human Resources Development for Poverty Alleviation, Bangkok, Thailand, 3-5 July 2008; Southeast Asian Fisheries Development Center, Bangkok, Thailand
- Poernomo, Achmad, Purwanto and Ahmadi. 2011. Combating Illegal, Unreported and Unregulated (IUU) Fishing to Attain Food Security and Alleviate Poverty: Initiative of Indonesia. *In*: Fish for the People, Vol. 9 No. 2 (2011). Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 79-85
- SEAFDEC. 2010a. Fishery Statistical Bulletin for the South China Sea Area 2007. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 165 p
- SEAFDEC. 2010b. Fishery Statistical Bulletin of Southeast Asia 2008. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 135 p
- SEAFDEC. 2012a. Fishery Statistical Bulletin of Southeast Asia 2010. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 143 p
- SEAFDEC. 2012b. The Southeast Asian State of Fisheries and Aquaculture 2012. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 130 p
- Sirimanotham, Chanthaboun and Bounleuam Norachack. 2008. Fisheries human resources development for poverty alleviation in Lao PDR. Paper presented during the ASEAN-SEAFDEC Regional Technical Consultation on Fisheries Human Resources Development for Poverty Alleviation, Bangkok, Thailand, 3-5 July 2008; Southeast Asian Fisheries Development Center, Bangkok, Thailand
- Toledo, Joebert D., Belen O. Acosta, Relicardo M. Coloso, and Evelyn Grace de Jesus-Ayson. 2011. Promoting Sustainable Aquaculture Development to Increase Fish Supply and Improve Livelihoods of Rural People in Southeast Asia. *In*: Fish for the People, Vol. 9 No. 2 (2011). Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 44-50
- Wongsanga, Pouchamarn and Virgilia T. Sulit. 2010. One Village, One Fisheries Product – for Food Security and Poverty Alleviation. *In*: Fish for the People, Vol. 8 No. 1 (2010). Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 4-7
- Wongsanga, Pouchamarn and Suriyan Vichitlekarn. 2010. Advancing the Promotion of FOVOP in the ASEAN Region: Issues and Challenges for Future Cooperation. *In*: Fish for the People, Vol. 8 No. 2 (2010). Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 11-14
- Yeap Soon Eong and Melvin Chow Wing Chung. 2011. Ensuring Quality and Safety of Fish and Fisheries Products through Improved Post-harvest Technologies and Safety Management Measures. *In*: Fish for the People, Vol. 9 No. 2 (2011). Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 51-57
- Yeap, S.E. and S.M. Tan. 2002. Issues facing the traditional fish products industry in Southeast Asia. The 9th JIRCAS International Symposium 2002: Value-Addition to Agricultural Products. Japan International Research Center for Agricultural Sciences (JIRCAS); pp 115-121

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Meeting Social and Economic Challenges in Southeast Asian Aquaculture: Targeting Rural Aquaculture Development for Poverty Alleviation

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In 2010, five Southeast Asian countries led by Vietnam and followed by Indonesia, Thailand, Myanmar, and the Philippines, have successfully joined the ranks of the world's top 10 producers of food fish from aquaculture. Taking into account aquaculture production in general which includes seaweeds, the region's production from aquaculture had contributed more than 45% to the region's total fishery production, about 24% to the world's production from aquaculture, and about 10% to the world's total fishery production in 2010. As shown in the statistics reports, most of the aforementioned countries recorded double-digit growth rates in aquaculture production from 2006 to 2010, ranging from 18 to 62 percent. Another milestone in the fisheries sector of the region is the engagement of about 11 million people in aquaculture and its ancillary industries. In spite of these figures, the region's rural areas where aquaculture development is taking giant strides remain the most impoverished groups in most countries of Southeast Asia. In an attempt to address this concern, SEAFDEC Aquaculture Department compiled the results of the implementation of its program on Meeting Social and Economic Challenges in Aquaculture which had been tried in local setting in the Philippines, with the objective of developing aquaculture technology adoption pathways that could be promoted in the other Southeast Asian countries with the same conditions as those in study sites in the Philippines, as means of alleviating poverty in rural areas.

The Southeast Asian region has been significantly contributing substantial volumes of fish from aquaculture to the world's total supply of fish. Of the world aquaculture production of about 60 million metric tons in 2010, about 24% was contributed by the Southeast Asian countries where aquaculture production during the past decade increased by more than three times from 4.2 million mt in 2001 to 14.2 million mt in 2010. Therefore, through aquaculture, the Southeast Asian region has the capacity of improving the availability and adequacy of supply of food fish not only for domestic consumption of its people but also for export. In 2010, five Southeast Asian countries were among the world's 10 highest producers of fish from aquaculture (Table 1). If production of aquatic plants is included in the 2010 total aquaculture production of the region, Indonesia would rank first among the countries followed by Vietnam, Philippines, Thailand, and Myanmar

Table 1. World's top ten producers of food fish from aquaculture

Production (mt)	World Rank	Country
36,734,215	1 st	China
4,648,851	2 nd	India
2,671,800	3rd	Vietnam
2,304,828	4th	Indonesia
1,308,515	5 th	Bangladesh
1,286,122	6th	Thailand
1,008,010	7 th	Norway
919,585	8 th	Egypt
850,697	9th	Myanmar
744,695	10th	Philippines
7,395,281	-	Others

Source: The State of World Fisheries and Aquaculture 2012, FAO, Rome, Italy

(Table 2). Following the current trend in terms of development and output, the region's aquaculture production volume which increased by more than 70% in 2001-2010, is expected to continue to increase in the next decades.

Based on such statistics, aquaculture could be seen as a sector that could enhance the economic development of the countries in the region while fulfilling the necessary protein requirement of the people especially those in rural areas. Meanwhile, trade of fish and fishery products with developed economies requiring high supply of food fish such as Japan, USA and the European Union, as well as intra-regional trade with countries such as Singapore, has been on the rise. As a result, the fisheries sector and its ancillary industries of Southeast Asia continue to benefit from the growth of export trade of fish, crabs, shrimps, shellfishes, and seaweeds, produced through aquaculture. However, it should be noted that the level of development of aquaculture and the distribution of benefits have varied widely across the countries of Southeast Asia.

Harvests from the region's fish farms of about 14.2 million mt in 2010 continue to feed significant number of people in Southeast Asia and its trading partners beyond the region. With about 52% coming from mariculture, 27% from freshwater culture and 21% from brackishwater culture (SEAFDEC, 2012a) the total production contributes significant volume of fish that fulfills the rice-fish diet of

Table 2. Total aquaculture production of the Southeast Asian countries (mt), 2006-2010

Countries	2006	2007	2008	2009	2010
Brunei Darussalam	700	674	390	460	421
Cambodia	41,400	50,200	39,720	50,000	60,000
Indonesia	2,377,474	2,466,030	3,855,200	4,780,100	6,277,923
Lao PDR	78,000	63,250	64,300	75,000	82,100
Malaysia	212,028	268,514	240,133	333,445	373,151
Myanmar	574,990	604,657	653,855	724,163	850,959
Philippines	2,092,275	2,214,826	2,407,698	2,477,392	2,545,765
Singapore	8,572	4,504	3,518	3,566	3,501
Thailand	1,353,021	1,370,431	1,330,800	1,396,010	1,286,117
Vietnam	1,687,717	2,194,500	2,468,320	2,539,300	2,706,800
TOTAL	8,426,187	9,237,586	11,063,934	12,379,436	14,186,737

Source: *Fishery Statistical Bulletin of Southeast Asia 2010*, Southeast Asian Fisheries Development Center, Bangkok, Thailand

most low and middle income-earning households both in rural and urban areas of the region.

The supply of freshwater species from aquaculture, such as tilapias, carps, catfishes, gouramis, and shrimps and prawns among others, has made fish affordable for many households throughout the region, especially in communities near the Mekong River Basin. In effect, the average fish consumption of Southeast Asia remained to be higher than 27.0 kg/person/year than the global average of 17.0 kg/person/year in 2009. In the case of archipelagic Philippines and Indonesia, production of milkfish in marine cages, ponds and pens have significantly augmented the demand gap for marine fish species due to declining catch from capture fisheries. Fish consumption in the Philippines at 28.0 kg/person/year is way above global average, and 4.0 kg of this comprised milkfish and 1.0 kg is tilapia, both species produced from aquaculture (BFAR, 2010).

The aquaculture growth in Southeast Asia is mainly driven by the scientific and technological breakthroughs developed in the region, as well as the level of adoption of the culture technologies among receptive and aggressive entrepreneurs. Countries with capital-rich entrepreneurs such as Thailand, Indonesia and Malaysia tend to profit more from aquaculture. Furthermore, institutional investment on aquaculture development has mainly centered on “research” and “development”.

Hence, the importance of sustainable and responsible aquaculture has not been adequately disseminated and understood in most rural communities. Meanwhile, in spite of increases in the region’s aquaculture production, the challenge to produce more fish does not cease as the region continues to deal with rapid increases in population and the need for food and livelihood by its people.

Nevertheless, statistics have shown that the average aquaculture production per fish farmer in Asia at 2.4 mt per year, is second lowest compared with Africa’s 2.0 mt per year (FAO, 2010).

Notwithstanding the problems and enormous needs, the present and future role of aquaculture in the region offer optimism as the region’s populace is projected to remain fish-eating. Therefore, the regional fish production of 31.5 million mt in 2010 (45% of which came from aquaculture) must have provided food fish to fulfill the region’s estimated consumption of about 16.7 million mt of fish, while also providing over 10.0 million mt to fish-deficit markets, without ignoring the amount of fish about 20% of the region’s fish production, which is converted into fish meal and fish oil (FAO, 2012). Nonetheless, such development implies that the region’s fish production including those from aquaculture could easily provide economic gains for the Southeast Asian countries.



Bountiful milkfish harvest from marine cages operated by fisherfolks in Guimaras Island, under the guidance of SEAFDEC/AQD

Rural Aquaculture Development in Southeast Asia

Considering the aforementioned scenario, it has become necessary for the region to ensure the successful adoption of aquaculture technologies and realignment of R&D direction and policies that would pave the way to improve livelihood and alleviate poverty in rural communities. Therefore, while acknowledging the global accounts of remarkable milestones of aquaculture in Southeast Asia, the *ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security Towards 2020: Fish for the People 2020 “Adaptation to a Changing Environment”* in June 2011 in Bangkok, Thailand, was of the general view that the development of aquaculture in the region should address the shortcomings and challenges especially in the development of the rural areas (SEAFDEC, 2011a; SEAFDEC, 2011b). In the midst of such realities and in order to ensure the sustainable development of aquaculture in the region, the Resolution adopted during the June 2011 ASEAN-SEAFDEC Conference implored the need (Item15) “to enhance the awareness that aquaculture makes to food security and sustainable livelihoods to deliver a responsible increase in aquaculture production that promotes aquaculture for rural development as means of rational use of land and water resources”. The accompanying Plan of Action (Item 14) specifically emphasized the need to “raise awareness of the need to develop financial incentives, especially for small-scale stakeholders and cooperatives, e.g. micro-credit, with national and regional institutional assistance for the responsible development of fisheries enterprises and developmental activities that will optimize socio-economic returns and food security”.

In this connection, the SEAFDEC Aquaculture Department (AQD) developed an R&D program, the so-called “Meeting Social and Economic Challenges in Aquaculture Program” or MSECAP to address the major issues and concerns in aquaculture that were identified during the ASEAN-SEAFDEC Conference. Therefore, relevant provisions stipulated in the 2011 Resolution and Plan of Action had been used as framework for the operationalization of MSECAP, the scope of which is shown in (Box 1).

Furthermore, in order to address the inadequacy of human resource to mediate the transfer of knowledge and practices of sustainable aquaculture technologies from researchers and fisher farmers, a holistic approach that includes the conduct of various training formats has been incorporated in the MSECAP. This is aimed at enhancing the extension and adoption of sustainable aquaculture technologies, especially in the remote rural fishing communities. In

Box 1. Scope of AQD’s Program on Meeting Social and Economic Challenges in Aquaculture (MSECAP)

- (i) Enhancing the role of aquaculture in addressing food, income and livelihood security through improved governance, multi-agency collaboration, and comprehensive and inter-disciplinary approaches;
- (ii) Promoting sustainable aquaculture through enabling policies that support the management of natural and environmental resources;
- (iii) Enabling mechanisms, institutions and infrastructure to encourage adoption of better aquaculture practices;
- (iv) Understanding and improving linkages from production to marketing and trade of fishery products to support small and medium enterprise (SME) development; and
- (v) Strengthening the capacity of aquaculture stakeholders by mainstreaming specific rural and peri-urban aquaculture programs and policies in local, national and international development programs.

addition, developing policies that will provide basis for the promulgation of practical aquaculture ordinances to be espoused by local government units is also being promoted as part of the MSECAP. Such ordinances are meant to guide and ensure the implementation of responsible aquaculture practices in the region.

SEAFDEC Initiatives to Address Social and Economic Challenges in Aquaculture

In an attempt to address the social and economic issues in aquaculture in Southeast Asia as called for in the 2011 Resolution and Plan of Action, AQD realigned its research and development (R&D) programs as a fundamental step towards unraveling the impinging aquaculture problems in the region. In particular, MSECAP (Box 2) is being promoted as means to develop and implement social and economic strategies in aquaculture and resource management to secure food and incomes of the region’s populace as well as alleviate poverty in rural communities through enhanced stakeholder-collaboration.

Box 2. Main objectives of MSECAP

MSECAP is aimed at:

- a) prioritizing collaborative R&D in aquaculture in the region to have a clear regional assessment and understanding of the role of aquaculture in poverty alleviation and provide basis for policy formulation;
- b) allocating R&D resources to address emerging issues on the impacts of climate change and global trade on aquaculture with emphasis on small-holder fish farmers; and
- c) enhancing multi-agency collaboration between and among SEAFDEC and its Member Countries, and other regional organizations to enhance sharing of information and resources towards alleviating the socioeconomic conditions of the poor sector of region.



Social and biological science researchers team-up in advancing technology dissemination and adoption by fisherfolk project co-operators



Grow-out cages for tilapia installed along irrigation ways in Dumarao to maximize water uses

Under the MSECAP, specific five-year targets (2012-2016) had been set (**Box 3**) through the implementation of R&D activities that explore the participatory and community-based modality in the promotion of aquaculture technologies in socially and economically disadvantaged rural communities. Initially conducted in the Philippines, socio-economic studies combined with on-farm site technology dissemination and demonstration activities are expected to deliver results that will converge towards developing prototype aquaculture technology adoption pathways suitable to the current social and economic development needs of the region, in accordance with the recommendations of the 2011 ASEAN-SEAFDEC Conference.

Specifically, the technology adoption models for inland and coastal aquaculture systems are foremost expected to secure food supply and livelihoods for households in

Box 3. Five-year targets of the Meeting Social and Economic Challenges in Aquaculture Program (MSECAP)

- Promotion of collaborative means of disseminating and adopting aquaculture technologies to secure food for inland and coastal communities, by:
 - co-establishing with stakeholders the necessary baseline information for designing demonstration activities that promote culture of new and indigenous aquaculture species in upland and inland communities; and
 - formulating appropriate adoption pathways for aquaculture technologies for the development of technology demonstration, implementation and adoption studies/activities.
- Assistance in the development of aquaculture-based small and medium enterprises (SMEs), by:
 - determining through season-long training, on-farm economic indicators for identifying viable technologies suitable for SMEs owned and operated by small-holder fish farmers; and
 - training fishers and other stakeholders on entrepreneurial skills and financial management of aquaculture enterprises.
- Enhancing the mechanisms for good governance and involvement of stakeholders in managing aquatic resources, through:
 - recommendations for the development of policies and up-scaled ordinances to support and maintain fisheries management mechanisms resulting from on-field studies; and
 - promotion of increased adoption of full-cycle aquaculture technologies among fish farmers to reduce and stop negative environmental impacts of unsustainable culture practices.
- Assistance to collaborators in the establishment of sustainable fish farm models that showcase commercially viable business using aquaculture technologies; through
 - recommendations for development of policies and up-scaled ordinances to support and maintain fisheries management mechanisms resulting from on-field studies; and
 - promotion of increased adoption of full-cycle aquaculture technologies among fish farmers to reduce and stop negative environmental impacts of unsustainable culture practices.
- Organization of a network of social science experts in aquaculture from all SEAFDEC Member Countries and partners, by:
 - enhancing the initiatives and collaboration forged by the ASEAN-SEAFDEC Human Resources Development Training in Rural Aquaculture in 2009 for launching further aquaculture capacity development training, and dissemination of aquaculture and resource enhancement protocols in the Region; and
 - conducting a regional workshop to enhance collaboration and address social science R&D and technology adoption action plans in inland and coastal communities, especially on matters for securing food and income through aquaculture in the region.



Tilapia cage culture along irrigation ways to secure fish supply in rural communities

Box 4. Strategies to promote MSECAP in the Southeast Asian region

On prioritizing collaborative R&D in aquaculture in the region. Through MSECAP, the foundation for conducting major activities to correspond to the three-pronged recommendations which are regional in scope had been established. Results of the partnership with various stakeholders at all levels constitute the technology adoption models that are verified and developed in various Philippine settings, which could be disseminated to the other Southeast Asian countries having similar environments as well as food and livelihood constraints. A regional network is therefore proposed, possibly anchored on the already established ASEAN-SEAFDEC Human Resources Development Program in Aquaculture, in the forthcoming years to disseminate R&D results that target the inclusive participation of marginalized stakeholders in social and economic development activities in aquaculture.

On allocating R&D resources to address emerging issues. MSECAP initiated a study on the verification, demonstration and adoption of cage culture of the giant freshwater prawn (*Macrobrachium rosenbergii*) among small-holder fish farmers in Laguna Lake near Metro Manila, Philippines. MSECAP is also engaged in other projects that demonstrate community-based activities to catalyze the promotion and adoption of hatchery and grow-out culture of freshwater species such as tilapia and catfishes in inland farming communities in Capiz Province in central Philippines, which had been confronted by changing rural landscapes due to construction of irrigation systems and facilities.

On enhancing multi-agency collaboration. The 2011 ASEAN-SEAFDEC Conference likewise recommended the need to implement collaborative ways for disseminating and adopting aquaculture technologies to secure food for inland and coastal communities; and sharing of information and resources between and among SEAFDEC and its Member Countries and other organizations in addressing the common problems of alleviating the socio-economic conditions of the poor sector of the region. To fulfill this recommendation, SEAFDEC/AQD has co-established with stakeholders the necessary baseline information for designing demonstration activities that promote the culture of new and indigenous aquaculture species in various rural settings.

diverse communities such as the remote rural, peri-urban and urban areas in Southeast Asia. Furthermore, these adoption pathways are envisioned to serve as guide in the promotion of aquaculture initiatives in other Southeast Asian countries with aquaculture potentials but with similar social and economic limitations as those in the Philippine settings. The strategies for the implementation of MSECAP with respect to the recommendations during the ASEAN-SEAFDEC Conference in 2011 are shown in **Box 4**.

Moreover, MSECAP is also envisioned to develop appropriate adoption pathways for aquaculture technologies that will guide technology demonstration, implementation and adoption in communities that were left behind in previous phases of aquaculture development. This adoption pathways will also document resource use changes over time as well as the socio-economic conditions in study sites with the adoption of aquaculture technology; examine the factors that contribute or impede the acceptability and



Tilapia cage culture in freshwater impoundments in Dumarao, Capiz could secure fish food for inland small-holder farmers



Fish cages in Laguna Lake near Metro Manila, Philippines for food security of fishers (Photo: D. Israel)

adoption of technologies; and determine whether there are differences in knowledge of and attitudes towards aquaculture technology adoption among community members and stakeholders, and between marine and freshwater culture environments.

Thus, prototype adoption pathways for inland freshwater aquaculture technologies is a work in progress under the MSECAP. The first case is in Dumarao, a farming municipality in the Province of Capiz in Western Visayas, Philippines (**Box 5**) for tilapia culture, and the other in fishing communities surrounding Laguna Lake in Luzon, Philippines (**Box 6**) for freshwater prawn grow-out culture, where the demonstration set-up attained a very high survival rate of 79%.

Box 5. Tilapia and catfish culture in flooded rice paddies in Dumarao, Capiz (central Philippines)

Development of the **technology adoption pathway for freshwater aquaculture** was based on the lessons learned from the implementation of the study on *Socio-economic Impact of Adoption of Sustainable Aquaculture Technologies in Selected Fisherfolk Communities* conducted by AQD in the municipality of Dumarao, Capiz Province in central Philippines. In this upland rural municipality, about 23.7 ha of agricultural lands in four villages had been submerged the whole year in 2006, while construction of an unfinished dam rendered many rice farm areas unsuitable for agriculture. With assistance of the local government of Dumarao, a cooperative of community members was organized to serve as recipient of aquaculture interventions. Thus, SEAFDEC/AQD introduced the tilapia grow-out technology in flooded rice farms through on-farm demonstrations of hatchery and grow-out operations in 2007. Although the technology spread to other villages, households with capital were the first to set up tilapia cage culture in submerged farmlands. However, investments were not sustained as operations were relegated to hired workers, but local residents with more entrepreneurial skills learned hatchery operations that contributed to improving the availability of tilapia juveniles. The result led to increased number of tilapia grow-out operators, but the cooperative did not prosper since the modality for introducing and maintaining grow-out culture as livelihoods was meant for farmers whose rice paddies had been affected by flooding. Meanwhile, some members of the cooperative who ventured on their own succeeded in sustaining their livelihoods, by operating their own farms, adapting the processes of culturing tilapia in backyard ponds using overflowing surface water, and practicing alternate feeding. On the average, tilapia growers in Dumarao mostly own one cage with size ranging from 4x2.5 to 4x10.0 meters, while only one grower has more than five cages. The growers reported obtaining positive income attributed to having pre-agreed selling price and harvest arrangements to minimize competition. Later in 2011, SEAFDEC/AQD also conducted on-site demonstration of induced spawning of catfish. Although unsuccessful during the initial attempts, some farmers expressed interest to pursue catfish culture when funds become available and weather conditions permit. The stakeholders generally acknowledged that the introduction of aquaculture technologies has improved the availability of fish for local consumption in an upland farming community, aside from creating new livelihoods for displaced rice farmers due to the changing landscape arising from infrastructure development.

Box 6. Collaborative cage culture of giant freshwater prawn with fish farmers in Laguna Lake

The prawn culture study in Laguna Lake near Metro Manila was conceived to respond to the need for actively promoting aquaculture technologies that offer livelihood opportunities to small-holder cage culture operators in peri-urban communities along Laguna Lake. Specifically, the study on cage culture of giant freshwater prawn (GFP) aims to: (i) conduct specific training programs to respond to the pressing need for extending the technologies to the Southeast Asian countries to improve livelihoods and economic development in the region; and (ii) ensure sustainable food supply particularly in remote rural areas of Southeast Asia. The hapa net cages set up in the lake-based facilities of AQD's Binangonan Freshwater Station (BFS) were stocked with GFP post larvae and fed commercial diet. The mean weight range per cage after five months culture was between 6.0 and 7.5 kg while the mean survival rate ranged from 46 to 56%. A group of fish farmers through their local government leaders were invited to take part during the sampling of the stocks. An ex-ante economic analysis of this culture system showed that Php 16,300 net income per module can be expected after 6 months culture period. Similar with other MSECAP activities, this initiative featured a multi-stakeholder collaboration to facilitate project implementation and optimize resource use. Small-scale tilapia fish farm operators signed in as direct project collaborators with the intention of obtaining additional incomes from GFP culture, where the fish farmers offered to modify their existing tilapia cages for GFP culture. Scoping for project partners and investors was promoted through consultations with the national fisheries government agencies such as the National Inland Fisheries Technology Center of the Bureau of Fisheries and Aquatic Resources, and Laguna Lake Development Authority. These agencies expressed interest in the promotion of GFP culture but immediate participation was limited by lack of financial resources for this purpose. Meanwhile, on-farm site cage culture with the fish farmer cooperators from neighboring areas of BFS commenced by training the fish farmer cooperators at the BFS facilities. While the modality of the techno-demonstration project including the details of the Memorandum of Agreement between AQD and the cooperators have been prepared, season-long training would commence after the stocking of post larvae in the cages of the fish farmer cooperators.

The cooperative organized by the Municipal Agriculture Office in Dumarao was originally meant to serve as the modality for promoting tilapia grow-out for livelihood development. However, the inactiveness of such cooperative suggests the need to evaluate the limitations of cooperatives as a platform for introducing aquaculture technologies and sustaining livelihood development. Considering that when tilapia cage culture operations individually carried out in areas that are mostly privately-owned by the members of the inactive cooperative and other villagers proved to be successful, this could imply that the engagement of various project stakeholders in Dumarao becomes the possible modality to guaranty common understanding and participation, aside from the well-recognized need to pool scarce resources among stakeholders in a small farming municipality with limited financial resources, and still keep up with the present economic development.

In the promotion of grow-out culture for the freshwater giant prawn in Laguna Lake, partnership with fish farmer cooperators from three neighboring villages of BFS together with key barangay officials is the essence of the on-farm site demonstration study. Scoping for additional investors in this technology promotion project was conducted by contacting the national government fisheries agency and a semi-government corporation that manages the lake resources. However, financial constraints limit their commitments to immediately participate in the project spite of the interest demonstrated. The on-going MSECAP studies are anchored on the context of multi-agency collaboration to enhance technology dissemination and adoption to secure food and create aquaculture livelihoods. In all these alliances, SEAFDEC/AQD provides technical support and ensures the availability of the necessary aquatic juveniles produced from AQD facilities at subsidized cost to farmer-cooperators.

At the local level, government funds and human resources with expertise in fisheries and aquaculture may be limited but local government units (LGUs) have the command authority to mobilize local municipal resources, especially the natural aquatic resources. For example, sustainable aquaculture development in the Philippines is guided by the Philippine Fisheries Code of 1998 and the 1991 Local Government Code of the Philippines. LGUs could therefore serve as critical catalysts in the promotion of aquaculture technologies for rural livelihood development.

The aquaculture adoption pathway for capture fishers also support the MSECAP in adversely-affected coastal communities such as the municipality of Nueva Valencia in Guimaras Province and also in Sagay, Negros Occidental. Mariculture of milkfish has been promoted in Guimaras Province, central Philippines with people's organizations



Project collaborators in Guimaras construct fish cages for milkfish culture using bamboo frames

Box 7. Milkfish cage culture introduced to fishers affected by oil-spill in Guimaras Strait

An aquaculture technology adoption pathway for coastal communities is being developed in the municipality of Nueva Valencia in Guimaras Province in Western Visayas, which was affected by an oil-spill accident in 2006, as means of supplementing and providing alternative incomes for affected fishers. A coordinated support program participated by Citi-Petron, the municipal and provincial government of Guimaras, and SEAFDEC/AQD was instrumental in introducing cage culture of milkfish in two fishing villages in the Nueva Valencia. The cooperative way of operating cage culture of milkfish through peoples' organization (PO) has been the modality for conducting aquaculture in the two barangays. Moreover, *Taytaysa Kauswagan*, Inc. (TSKI), a non-government micro-finance institution, was tapped in 2010 to prepare and equip fisherfolk associations with enhanced skills to manage a sustainable community enterprise. Overall, milkfish cage culture generated positive incomes when the POs were under close supervision and training by SEAFDEC/AQD. When the POs operated their own fish cages in their respective areas, only one PO reported positive income where the technicians (caretakers) shared 80% of the profit as their wages while 20% went to the PO. The technicians claimed that their wages were reasonable considering that they work on rotation basis per week and still have time to go fishing or be involved in other livelihood activities. Meanwhile, the milkfish cage culture operations by the POs are on hold for review and assessment, while a new concept paper was submitted to the funding agency (Citi-Petron) to ensure the sustainability of the livelihood project. The establishment of a mariculture park in the area was also proposed with the qualified PO members targeted as adopters of the technology through a rent-to-own scheme. Furthermore, with the heightened interest on aquaculture as source of added income, the POs are waiting for the approval of their proposed sea cucumber grow-out culture project which was submitted to the Philippine Business for Social Progress (PBSP) for possible funding support. Some PO members showed interest in seeding their coastal waters with sea cucumber to enhance productivity, while claiming that it is not difficult to monitor the growth of sea cucumber and oversee the area since their coastal area is quite small.

(POs) to address emerging problems, specifically pollution caused by oil-spill as well as externalities from other industries. Thus, R&D allocations under the MSECAP have been based on the varied experiences of fisher-participants in their milkfish cage culture operations in Guimaras Province (**Box 7**).

Results of the study on milkfish cage culture suggested that organizational and management problems are the most challenging aspect of aquaculture technology adoption and delivery of impacts. The technology adoption pathway in oil-spill affected areas is especially developed for affected stakeholders in Guimaras Strait with the collaboration of Citi-Petron Foundation and the local government units in the study site. Mariculture of milkfish has been promoted as means of generating alternative livelihoods for the affected fishers.



Researchers work with fisherfolk in on-site sea cucumber cages in tidal flats to develop livelihood options while ‘no take’ regulations are in place during stock enhancement programs

Enhancement of threatened high-value marine species such as abalones and sea cucumbers in coastal communities in the Visayan Seas in Negros Occidental is also being carried out to determine the measures for alleviating depletion of aquatic resources due to overfishing and habitat degradation (**Box 8**). Results of the R&D studies have shown the adoptability and biological suitability of the hatchery and grow-out technology, as well as the preliminary resource

Box 8. Cage culture of abalone to complement livelihoods during “no-take” periods

Aquaculture of abalones in floating long-line cages is being tested in Brgy Molocaboc in Sagay, Negros Occidental in Western Visayas, Philippines. Aquaculture is meant to be a component of a stock enhancement program being implemented by SEAFDEC/AQD in collaboration with municipal and barangay government units. Thus, aquaculture of high-value abalones is being promoted to provide incomes to fishers participating in stock enhancement programs, considering that economic benefits from stock enhancement generally materialize after a long period of “no-take” fisheries management regime to allow rehabilitation of the enhanced stocks. Hence, an adoption pathway for aquaculture technology that generates incomes and livelihoods during resource enhancement and habitat rehabilitation programs is one of the action-oriented social science research studies, which is being conducted by SEAFDEC/AQD. Although the staggered releases of tagged hatchery-bred abalone juveniles in a community-based resource enhancement demonstration site showed positive results in terms of recaptures, growth and survival, the participation of the community in securing the community-based demo-sites against poachers has been challenged by expectations of immediate economic incentives among stakeholders, either in cash or in kind. Nonetheless, in order to facilitate the introduction of income-generating aquaculture livelihoods to fishers, members of the Barangay Fisheries and Aquatic Resources Management Council (BFARMC) who could serve as promoters for the culture of abalone as livelihood options, were trained in abalone and sea cucumber culture in SEAFDEC/AQD.

enhancement protocols developed by SEAFDEC/AQD. In Sagay, Negros Occidental for example, recapture of 4,000 tagged hatchery-bred abalone juveniles in a community-based resource enhancement site showed positive results. The average monthly growth rate of about 1.0 cm and high survival of the released abalones exhibited the suitability of introducing such technological protocols with indigenous knowledge to local fishers.

In order to encourage the participation of communities in securing community-based resource enhancement demo-sites against poachers, immediate economic incentives for stakeholders could be an option. Nevertheless, SEAFDEC/AQD tried to improve the technological capacity of fishers and members of the Barangay Fisheries and Aquatic Resources Management Council (BFARMC) by training them in abalone and sea cucumber culture at the AQD facilities in Tigbauan, Iloilo, Philippines. It is envisaged



BFARMC officers and members join and learn from researchers while monitoring abalone resource enhancement and cage culture livelihood demo-sites in Sagay, Negros Occidental



Hatchery-bred abalone juveniles transported in pipes during acclimation in study sites

that the technology on grow-out culture of abalone in trays in hanging long-lines could provide the livelihood options in lieu of immediate economic gains expected from resource enhancement activities.

The study in Sagay Marine Reserve in Negros Occidental which focuses on the development of strategies for managing enhanced stocks of abalone and sea cucumber, demonstrates and evaluates the role of collaboration between the community of fishers that directly participate and provide manpower to the project, the local government units and traders that provide logistics and governance support, and SEAFDEC/AQD that provides scientific and technical backing. Therefore, collaborative engagements for generating complementary culture-based livelihoods, such as grow-out of high-value abalones in marine cages during “no-fishing” regulations as a strategy in resource rehabilitation and enhancement periods, have been seen as the modality for addressing the need for enhancing incomes among participating stakeholders.

Aside from specific R&D studies being conducted under the MSECAP, SEAFDEC/AQD continues to conduct capacity building programs that facilitate the dissemination of aquaculture technologies for rural development in the Member Countries of SEAFDEC. These initiatives are intended to converge towards improving social and economic conditions of aquaculture stakeholders. For instance, a series of on-site training on mud crab farming and a regional training on community-based freshwater aquaculture for remote areas of Southeast Asia have been promoted in Myanmar and in the Philippines, respectively.

Control of fish diseases and the promotion of fish health under farming conditions are essential components of



On-site training on Freshwater Fish Health Management in Myanmar

aquaculture to ensure a stable supply of fish products. Hence, an important initiative of SEAFDEC/AQD in the region focuses on fish health management which is meant to accelerate the awareness of fish farmers in resource-deprived SEAFDEC Member Countries through industry-wide capacity building and research activities. An important component of this project is the implementation of regular training program on fish health management at AQD facilities in Iloilo, Philippines and on-site training in Member Countries with focus on the Mekong region, as well as through AQD’s biennial distance learning program on fish health management.

Concluding Comments

The MSECAP foresees that a direction towards an inclusive and holistic development of aquaculture in Southeast Asia can be realized by identifying and implementing various typologies of aquaculture technology adoption models suitable to the social and economic needs of the people of the region. This calls for specific strategies that will involve the integration of aquaculture technology adoption pathways in rural development planning and implementation.

The future directions could broadly include: (i) enhancing support for sustainable aquaculture in the national to local programs and policies; (ii) motivating governments to mainstream aquaculture in rural development; and (iii) applying precautionary and ecosystems approach in aquaculture. As distinctly specified in the *Resolution and Plan of Action* adopted during *ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security Towards 2020: Fish for the People 2020 “Adaptation*



AQD scientists conduct training course on mud crab farming in Myanmar, in collaboration with Department of Fisheries

to a Changing Environment” in June 2011, national programs and policies on aquaculture in the Southeast Asian countries should address the pressing social, economic and environmental aspects of sustainable aquaculture that directly impact rural development, *i.e.* aquaculture programs should contribute to improved food security, livelihoods, employment, and poverty alleviation. In particular, governments at all levels have been encouraged to integrate aquaculture into rural development planning within the context of multiple uses of land and water resources. Thus, inter-agency coordination is very crucial in policy formulation, project planning and implementation, stakeholder consultation, extension services, and technology transfer.

Mainstreaming aquaculture in rural development will require the participation of all concerned and support to regional initiatives that will assess the role of aquaculture in poverty alleviation for better policy formulation. In order to realistically integrate aquaculture activities in community development plans, compliance to national employment practices, facilitation of financial incentives and credit schemes, and promotion of investments in ancillary and other support structures to motivate aquaculture enterprises are necessary, as stipulated in the 2011 Plan of Action.

Public-private modalities to catalyze the integration of aquaculture in rural development are also crucial, while precautionary approach through the ecosystems approach to fisheries management being admonished by FAO in effect applies a preventative approach to safeguard the environment from rapid development of offshore aquaculture, and likewise consider development of a regional guidelines on responsible marine (inshore and offshore) aquaculture. In rural development scenarios, a precautionary and ecosystems principle will benefit protective and conservation measures that are critical in the practice of aquaculture in fragile environments. Ecosystems approach therefore beneficially magnifies the interconnectedness between the human and ecological dimensions in the utilization of natural resources in aquaculture to create an inclusive development, *i.e.* including those marginalized stakeholders during the early phases of aquaculture development in the region.

References

- BFAR. 2010. Philippine Fisheries Profile in 2009. *In:* [http://www.bfar.da.gov.ph/pages/AboutUS/maintabs/publications/pdf%20files/2010%20Fisheries%20Profile%20\(Final\).pdf](http://www.bfar.da.gov.ph/pages/AboutUS/maintabs/publications/pdf%20files/2010%20Fisheries%20Profile%20(Final).pdf)
- FAO. 2009. The State of World Fisheries and Aquaculture 2008. FAO, Rome, Italy; 176 p
- FAO. 2010. The State of World Fisheries and Aquaculture 2010. Food and Agriculture Organization of the United Nations. Rome, Italy; 197 p
- FAO. 2012. The State of World Fisheries and Aquaculture 2012. Food and Agriculture Organization of the United Nations. Rome, Italy; 209 p
- SEAFDEC. 2011a. Proceedings of the *ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security Towards 2020: Fish for the People 2020 “Adaptation to a Changing Environment”*, Volume I: The Conference Proceedings, 13-17 June, Bangkok, Thailand, Southeast Asian Fisheries Development Center, Bangkok, Thailand; 258 p
- SEAFDEC. 2011b. Proceedings of the *ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security Towards 2020: Fish for the People 2020 “Adaptation to a Changing Environment”*, Volume II: Thematic Panel Sessions, 13-17 June, Bangkok, Thailand, Southeast Asian Fisheries Development Center, Bangkok, Thailand; 311 p
- SEAFDEC. 2012a. The Southeast Asian State of Fisheries and Aquaculture 2012. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 130 p
- SEAFDEC. 2012b. Fishery Statistical Bulletin of Southeast Asia 2010. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 143 p

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Value-adding of Freshwater Fishes for Poverty Alleviation and Food Security in Southeast Asian Countries

Yeap Soon Eong

Freshwater aquatic species are important fishery resources for many countries in Southeast Asia, providing the most needed animal protein for people in marginalized and poor fishing communities thus, contributing to food security especially in rural areas. Southeast Asia is known for its traditional fish products generated by household producers as well as small and medium-sized establishments which are usually family-owned business ventures and operated as backyard industry. Value-adding has been introduced in the fish processing industry to transform low-value fishes into various fish products with enhanced economic value in order to increase incomes and subsequently, enhance the socio-economic conditions in rural fishing communities. Thus, value-adding could contribute to poverty alleviation and food security for these communities. Some of the freshwater fish species produced in the region could be under-utilized and of low-value in view of the preference of consumers for the high-value marine aquatic species. Considering the continuous decline of the marine resources, it has become necessary to maximize the utilization of freshwater fish resources by converting certain quantities of freshwater fishes into value-added products that are acceptable in domestic as well as in international markets, thus, enhancing the contribution of freshwater fisheries to food security and poverty alleviation in the Southeast Asian region.

Many countries in Southeast Asia produce considerable quantities of traditional fish products such as fish sauce and other forms of cured and fermented fish products, which represent a significant component of fish utilization in the region. Yeap and Tan (2002) cited that processing of traditional fish products which accounts for 30-45% of the region's total fisheries production, is the most important means of preserving fish in many developing countries where post-harvest facilities including those for maintaining the freshness of fish are inadequate (Yeap *et al.*, 2007). Fish sauce is the most important traditional fish product produced by most countries in the region. It is widely used as a condiment or as an ingredient in cooking to add flavor to a number of dishes (MFRD, 2003). In addition, other fish products which serve as major traditional source of animal protein, have been developed in Southeast Asia using marine and freshwater fishes as raw materials (MFRD, 2002).

In general, traditional fish products such as fish sauce and other cured fish products are mostly consumed domestically in most countries of Southeast Asia. However, some countries in the region have been exporting traditional fish products to countries with considerable number of inhabitants originating from Southeast Asia, but trading of such products has been constrained by requirements for improved processing and compliance with the safety and quality requirements of export products. In order to assist the countries in the region in improving their traditional fish products, SEAFDEC through its Marine Fisheries Research Department (MFRD) has promoted the development of sustainable fishery post-harvest technology in Southeast Asia aimed at enhancing the production of safe and quality fish and fishery products. This is also meant to make the region's fish and fishery products more competitive in the world market and generate increased incomes to improve the economies of the countries in the region. Nevertheless, Goh and Yeap (2007) emphasized that the development of fishery post-harvest technology could be made sustainable by maximizing the utilization of fish catch while minimizing post-harvest losses and at the same time ensuring the safety and quality of the fish and fishery products.

SEAFDEC's program on sustainable fishery post-harvest technology paved the way for the development of the surimi industry in Southeast Asia in the 2000s, considering that in the 70s little was known about the surimi technology in the region (Yeap and Chow, 2011). The surimi industry in the region which makes use of low-value marine fishes, has come up with a wide range of value-added products for human



consumption such as fish sausage, fish loaf, fish burger, fish tofu, fish bah kwa, fish floss, fish cracker, fish siew mai, fish muffin, and so on. Moreover, by-products from tuna and swordfish processing have also been turned into fish products for human consumption such as breaded and buttered products, and fish sausage. Furthermore, efforts have also been made to improve the quality of traditional fish products by going into simple mechanization to increase productivity and introducing the concept of Hazard Analysis and Critical Control Point (HACCP) to ensure the quality and safety of the products. As a result, about 200,000 tons of surimi was produced in the region in 2009 accounting for about 30% of the world's total surimi production (Yeap and Chow, 2011) while value-added products continued to be generated by the fish processing industry in the region contributing substantially to the world's total production of value-added fish products.

Status of Freshwater Fish Production in the Southeast Asian Region

The current status of marine fishery resources in the region has been reported to be dwindling. As such, the resources may not be able to sustain its role in supplying the raw materials needed to generate a considerable amount of value-added fish products. This is therefore the opportune time to turn the focus on the development of fish products using low-value freshwater fishes through value-adding. Since freshwater fishery resources in Southeast Asia are being harvested from rural fishing areas where storage facilities are inadequate, it has become considerably important to maximize the economic value of the fishery resources through value-adding to ensure that the contribution of freshwater fisheries to food security and poverty alleviation in the rural areas of the region is enhanced.



Southeast Asia produces considerable quantities of freshwater fishes that could be utilized extensively as raw materials in the fish processing industry. In 2010 for example, the total fisheries production of the Southeast Asian countries was reported to be about 31.5 million metric tons (mt) and valued at about US\$38.8 billion (SEAFDEC, 2012). Of this total, 14.9 million mt was contributed by marine capture fisheries, 2.4 million by inland capture fisheries while 14.2 million mt came from aquaculture. With the contribution of freshwater aquaculture of about 3.1 million mt to the total production from aquaculture, this implies that a total of about 5.5 million mt of freshwater aquatic species had been produced in Southeast Asia in 2010 (Table 1). This production accounts for about 18% of the region's total fisheries production in terms of volume and about 17% in value, offering the possibility of increasing the economic value of freshwater fishes by turning them into processed products through value-adding. Consequently, the contribution of freshwater resources to food security and poverty alleviation especially in the remote rural areas is enhanced through the generation of value-added fish products.

Table 1. Production from inland capture fisheries and freshwater aquaculture of the Southeast Asian Countries (2010)

Countries	2010 Production from Inland Capture Fisheries		2010 Production from Freshwater Aquaculture		Total Fisheries Production in 2010	
	Volume (mt)	Value ('000 US\$)	Volume (mt)	Value ('000 US\$)	Volume (mt)	Value ('000 US\$)
Brunei Darussalam	-	-	19	150	2,772	11,626
Cambodia	405,000	-	-	-	550,000	533,528
Indonesia	344,972	-	1,347,183	2,134,415	11,662,311	14,085,949
Lao PDR	30,000	93,168	82,100	-	113,000	204,969
Malaysia	4,545	13,138	155,398	252,161	1,806,577	2,821,786
Myanmar	1,002,430	1,503,645	772,396	724,138	3,901,979	5,821,638
Philippines	185,406	174,479	308,093	419,786	5,155,647	4,534,628
Singapore	-	-	403	1,660	5,233	25,423
Thailand	209,800	288,277	432,378	654,223	3,113,316	4,501,934
Vietnam	194,200	-	-	-	5,127,600	6,941,179
TOTAL	2,377,253	2,526,476	3,097,970	4,186,533	31,438,435	31,802,983

Source: Fishery Statistical Bulletin of Southeast Asia 2010, Southeast Asian Fisheries Development Center, Bangkok, Thailand, June 2012

The four CLMV countries, namely: Cambodia, Lao PDR, Myanmar and Vietnam, together accounts for more than 50% of the region's total production from inland capture fisheries and freshwater aquaculture notwithstanding the insufficiency of relevant data provided by some countries. Therefore, sustainable utilization of the freshwater fish resources is necessary to ensure that the countries could make full use of their resources and alleviate poverty especially in rural fishing communities.

Utilization of Freshwater Fishes for Value-added Products

MFRD has been conducting projects on the maximum utilization of fish catch which included components on the use of under-utilized marine fish species as well as under-utilized freshwater fish species for the development of value-added products since 2002. For the utilization of freshwater fish species, the activity was launched in Cambodia in 2004 and later in 2011 in Lao PDR, Myanmar and Vietnam, while Indonesia is also participating in the activity considering its substantial production volume of freshwater fishes from inland capture fisheries as well as from freshwater aquaculture as shown in **Table 1**.

With the main objective of developing a new range of value-added products from underutilized freshwater fishes, the activity enabled the conversion of freshwater fishes into value-added products for human consumption as well as for trading in international market. The main objective of the activity is to increase the contribution of freshwater fisheries through value-adding to food security and poverty alleviation especially in the aforementioned four countries. Moreover,

the transformation of under-utilized freshwater fishes into value-added products, which are acceptable to the palate of the peoples in the Southeast Asian region as well as in other regions of the world, has been envisioned to provide alternative sources of fish protein for human nutrition in view of the imminent shortage of traditional marine fish resources in Southeast Asia that could supply the demand of its ever growing population.

During the first stage of the activity which was conducted with the collaboration of the Fisheries Administration (FiA) of Cambodia in 2004, common freshwater fish species which are abundant in the Tonle Sap Great Lake of Cambodia, were identified for value-adding, namely: the featherback (*Notopterus* spp.), snakehead (*Channa micropeltes*), moonlight gourami (*Trichogaster microlepis*), and soldier river barb (*Cyclocheilichthys enoplos*). Thus, surimi was developed from fresh featherbacks and snakehead fillets while fish siew mai, fish tofu, fish crackers and fish bah kwa were produced from featherbacks, snakeheads, and gouramis. Fish *satay* and fish *marukku* were also developed from the soldier river barbs.

The activity was however, discontinued after the completion of the SEAFDEC Special Five-Year Program in 2005. With the intention of reviving the activity for the benefit of the rural fishing communities in the region, the Government of Singapore initiated a three-year project on the utilization of freshwater fish for value-added products in 2011 for Lao PDR, Myanmar and Vietnam with Indonesia also indicating interest to take part in the implementation of the activity, which also envisions to upgrade the processing and packaging technology of value-added products from freshwater fishes and to extend assistance to the participating countries in this endeavor.

As envisioned, the new products to be developed should aim for the small and medium enterprises in which case, the utilization of simple and easy-to-use equipment and technology were emphasized. Processing trials and product development were conducted in the participating countries involving commercial cooperants. In order that these countries could take off with their project plans, a regional training course on processing value-added products using freshwater fish was organized in October 2011, to equip the participants with the basic techniques and equipment necessary for the development of value-added fish products. The training included lectures on processing value-added products, Good Manufacturing Practices (GMP), Hazard Analysis and Critical Control Point (HACCP), and product shelf-life testing. In addition, practical sessions were conducted that enabled the participants to process six types of value-added products, namely: fish sausage, fish patty, spicy fish paste, fish *murukku*, fish *siew mai*, and fish crackers.



Way Forward

MFRD will compile the results of the processing trials and product development conducted by the participating countries, to be included in a handbook on processing of value-added freshwater fish products. MFRD will also organize an End-of-Project Seminar in 2013 to provide the participating countries an opportunity to discuss and share the results of their respective project activities. Moreover, the results could also be used as a reference in mobilizing One Village, One Fisheries Product (FOVOP) by the Southeast Asian countries. FOVOP is aimed at promoting the creation of economic activities in the rural communities to enable them to carry out alternative and supplemental livelihoods that could alleviate poverty and attain sustainable fisheries development and management as well as food security. One of the major components of FOVOP includes the development and improvement of products and services as well as human resources and entrepreneurial capacity (SEAFDEC, 2010). This activity implemented by MFRD therefore fits well into the promotion of FOVOP in the Southeast Asian region.

This is also intended to address specific provisions in the 2011 Plan of Action adopted during the ASEAN-SEAFDEC Conference in June 2011, on the need to “*introduce and provide support for the development and application of technologies that optimize the utilization of catches, reduce post-harvest losses, wastes and discards in commercial and small-scale fisheries and processing operations, through improved processing, facilities and infrastructure development, on-board and on-shore handling, storage, distribution and marketing of fish and fishery products,*” and on the need to “*promote the production of and preserve the diversity of traditional fish products by assisting producers to secure stable supplies of quality raw materials, meet food safety requirements and to improve product identity, nutritive value and marketing. In the process promote One Village, One Fisheries Product (FOVOP) and other initiatives to promote local fishery products*”.



References

- Goh Kian Heng and Tan-Low Lai Kim. 2008. Maximizing the Utilization of Fish Catch for Human Consumption. *In: Fish for the People* Vol. 6 No. 3 (2008), Southeast Asian Fisheries Development Center; pp 27-30
- Goh Kian Heng and Yeap Soon Eong. 2007. Towards Sustainable Post-harvest Technology Development in the ASEAN. *In: Fish for the People* Vol. 5 No. 2 (2007), Southeast Asian Fisheries Development Center; pp 2-7
- MFRD. 2003. Fermented Fish Sauce in Southeast Asia. SEAFDEC Marine Fisheries Research Department, Singapore; 61 p
- MFRD. 2005. Maximizing Utilization of Fish Catch – Freshwater Species. SEAFDEC Marine Fisheries Research Department and Department of Fisheries Cambodia, MFRD Singapore; 42 p
- SEAFDEC. 2010. Regional Guidelines for the Promotion of “One Village, One Fisheries Product” (FOVOP) in the ASEAN Region. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 31 p
- SEAFDEC. 2011. Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 23 p
- SEAFDEC. 2012. Fishery Statistical Bulletin of Southeast Asia 2010. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 143 p
- Yeap Soon Eong and Melvin Chow Wing Chung. 2011. Ensuring Quality and Safety of Fish and Fisheries Products through Improved Post-harvest Technologies and Safety Management Systems. *In: Fish for the People* Vol. 9 No. 2 (2011), Southeast Asian Fisheries Development Center; pp 51-57
- Yeap Soon Eong, Ira Hariono and Virgilia T. Sulit. 2007. Assisting ASEAN Fish Processing Meet Safety and Quality Assurance Requirements. *In: Fish for the People* Vol. 5 No. 2 (2007), Southeast Asian Fisheries Development Center; pp 21-27
- Yeap, S.E. and Tan, S.M. 2002. Issues facing the traditional fish products industry in Southeast Asia. 9th JIRCAS International Symposium 2002: Value Addition to Agricultural Products; pp 115-121

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Enhancing Stakeholders' Role in the Value Chain for Sustainable Fisheries Development: A Case of Anchovy Fisheries in Vietnam

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In the case of Vietnam, globalization has created not only favorable conditions for the development of the country's commercial fisheries but also brought about challenges in addressing the requirements of the fish consuming public, e.g. food hygiene and safety, traceability and environment-friendly production. In order to secure a niche in the world's fish market, the sustainability of the country's fisheries industry should be ensured, which could be achieved by focusing on strengthening its value chain for fish and fishery products. This article attempts to study the features of the value chain of anchovy products and offers policy recommendations for the sustainable development of anchovy fisheries in Khanh Hoa Province, Vietnam.

In Vietnam, anchovy fisheries is one of main livelihoods for thousands of coastal fishers and is also a source of vital income for stakeholders involved in the process of production and distribution of anchovy products. However, the sustainability of the country's anchovy fisheries is challenged by various concerns that include the decreasing and depleting fishery resources, the seemingly unequal benefits gained by various stakeholders along the supply and market chains, the need to comply with requirements for traceability by importing countries, among others. Therefore, the need to assess the value chain of the anchovy products has become necessary in order to examine the benefits that stakeholders could obtain from the fishery while also ensuring the sustainability of anchovy fisheries and fulfilling the food safety requirements of importing countries. The Structure-Conduct-Performance (SCP) approach was used to identify and analyze the linkage among stakeholders involved in the production and distribution of anchovy products. Considering that the fishers is always at the losing end and getting the least benefits in the value chain, the role of the anchovy fishers along the value chain should be enhanced for the sustainable development of anchovy fisheries in Vietnam.

As defined in many references (**Box 1**), value chain could be summarized as a sequential set of processes that aim to transform inputs into value-added outputs that cater to the requirements of the market. The aspect of value-adding involves the entire supply chain activities from determining the preference of customers to products development until production and distribution of the end products. Specifically in fisheries, supply chain is a set of processes to generate fish

and fishery products, i.e. culture, harvesting, transforming or manufacturing, and delivery of the products to target market, i.e. marketing and distribution.

Box 1. Compiled definitions of value chain vis-à-vis supply chain

The entire set of processes and activities required to put up a product then deliver it to a target market is considered as supply chain, where "putting up a product" encompasses growing, transforming or manufacturing. For fisheries, the entire chain goes from oceans or farms to tables. Smooth functioning of value chain requires not only the factors of production and technology but also efficient transport, marketing information systems and management. While value chains are concerned with what the market will pay for goods or services offered for sale, supply chains focused on the costs and how long it takes to present the goods for sale. While supply chain management aims to reduce the number of links and reduce friction such as bottlenecks, costs incurred, time to market, value chain management strives to maximize gross revenue and sustain it over time. Good supply chain is therefore essential to develop a value chain. In a value chain, products pass through all activities of the chain in order, where the product gains some value at each activity. It is a physical representation of the various processes involved in producing goods (and services), starting with raw materials and ending with the delivered product passing through the supply chain. It is based on the notion of value-adding at every activity to obtain the total value of the value-added yields.

Anchovy Fisheries in Vietnam

Anchovies are among the most important pelagic fishes of the Southeast Asian region. Of the 13 species of anchovies under the genus *Stolephorus* found in the region, *S. heterolobus* and *S. indicus* are the most common (SEAFDEC, 2012). Although the fishery statistical report of Vietnam does not show the country's actual production of anchovies as the information is combined with those for marine fishes *nei*, it is a common fact that the country's anchovy resources are exploited by anchovy purse seines that operate in the waters of the central and southern provinces of the country. With the catch from the purse seines in the central and southern areas of the country accounting for about 8% and 12% of the country's total catch from marine fisheries, respectively (SEAFDEC, 2002), this implies the importance of anchovy fisheries to the economic development of the country. Moreover, Vietnam is also famous for its fish sauce, which is derived from fermented anchovies. In 2011, the fish sauce production of Vietnam was about 250,900 tons worth about VND 6,664.6 billion (Euromonitor International, 2011). While the market of the

Table 1. Anchovy fishing vessels sampled in Khanh Hoa Province (by engine power groups)

Engine power group	Cam Ranh			Nha Trang		
	Population	Sample	Sampling rate (%)	Population	Sample	Sampling rate (%)
20-44 HP	147	14	9.5	60	12	20.0
45-90 HP	71	7	9.9	48	13	27.1
Total	218	21	9.6	108	25	23.1

Table 2. General information on anchovy fishing vessels in Khanh Hoa Province

Criteria	Mean	Max	Min	SD
General information				
Hull length (m)	13.9	16.7	11.6	1.4
Engine power (HP)	45.7	80.0	20.0	16.4
Fishing trips per month (trips/month)	22.3	25.0	21.0	1.2
Fishing months per year (months/year)	10.0	10.0	10.0	0.0
Crew size (person)	9.6	12.0	8.0	1.3
Experience of skippers (years)	12.5	18.0	7.0	3.2
Average harvest (kg/trip)	464.6	680.0	300.0	96.4
Expenditure (Million VND)				
Average fixed costs in one year	84.0	118.0	60.5	17.2
Average variable costs in one year	176.7	364.1	122.1	39.9

famous Vietnamese fish sauce is expected to continue to grow steadily in the coming years, this makes anchovy fisheries becoming much more economically significant for Vietnam.

The Case Study

In order to ensure the sustainability of the anchovy fisheries in Vietnam, notwithstanding the status of its anchovy resources, a case study was conducted in Khanh Hoa Province to assess the role of fishers in the value chain for anchovy products and develop policy recommendations for the sustainability of anchovy fisheries. Specifically, the case study was aimed at analyzing the structure of value chain of anchovy products and the role of stakeholders involved in the production, assessing the distribution of benefits among the stakeholders in the value chain, and providing recommendations for improving the anchovy product's competitiveness in the world market, and eventually promoting the sustainable development of the country's anchovy fisheries.

For the case study, interviews were conducted with stakeholders involved in anchovy fisheries such as the fishers, middlemen, fish sauce companies, fish processing companies, traders, retailers, and consumers in Khanh Hoa Province, more particularly in Nha Trang and Cam Ranh. Stratified sampling survey was carried out in 2010 to collect data for 2009 involving 46 fishing households, 2 fish sauce companies, 1 fish processing company producing anchovy products for export, 2 primary middlemen, 1 secondary middleman, and 2 fish processing companies producing anchovy products for

domestic market. In the survey, two groups of samples were taken from Cam Ranh (Binh Ba- Binh Hung Island and Ba Ngoi communes) and another two from Nha Trang (Vinh Truong and Vinh Nguyen communes). A summary of the information on the anchovy fisheries in the study area is shown in **Table 1** while **Table 2** presents additional information on anchovy fishing vessels in Khanh Hoa Province.

At the start, mapping was used to identify the stakeholders involved in the distribution of anchovy products, as well as the input and output costs incurred by each stakeholder in the value chain. Then, the relationships among the three basic elements in the value chain, *i.e.* market structure, market conduct, and market performance were determined using the SCP approach (Krishnan and Narayanakumar, 2010; Trondsen, 2003). However, due to limited data, only some key elements had been included in the analysis as shown in **Fig. 1**.

Market Structure

Stakeholders involved in the value chain of anchovy products

Results of the study revealed that two levels of middlemen are involved in the distribution of anchovy products, the primary and secondary middlemen. The common characteristics of the value chain for anchovy products in Khanh Hoa Province, Vietnam shown in **Fig. 2** indicate that primary middlemen serve as link between the fishers and the secondary middlemen. While the buying segment of primary middlemen

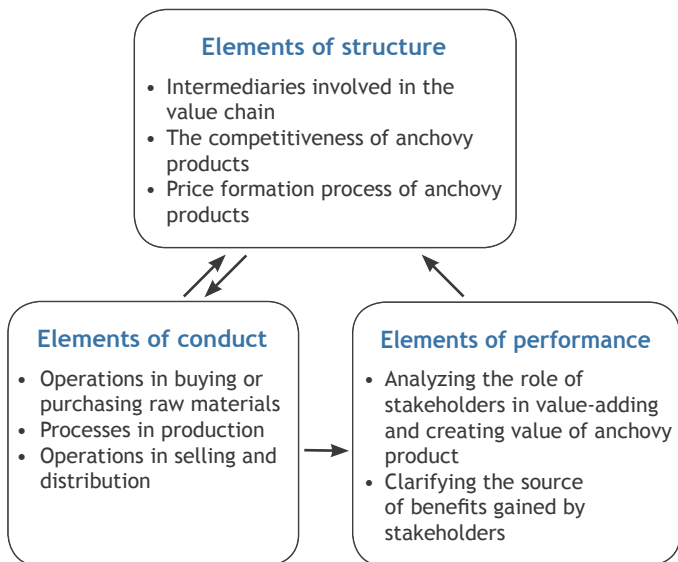


Fig. 1: Application of SCP approach to assess the three market elements of anchovy products

is at sea, that of secondary middlemen is on land. Middlemen are oftentimes local citizens who have adequate knowledge with regards to good quality fish and the seasons for high catch. Usually, middlemen belong to affluent families, especially the secondary middlemen who have the power to dictate the prices of fish because they are normally the source of loans availed by fishers for their operating as well as other family expenditures.

While in Nha Trang, there were three secondary middlemen buying anchovy products for export and approximately 10 primary middlemen working with anchovy fishers, the situation in Cam Ranh was different as there were 25 primary middlemen mostly coming from nearby islands. Results of the survey further revealed that some of the secondary middlemen also operate small-scale companies engaged in drying or

freezing anchovy products meant for export to Korea or Japan. Middlemen continue to exist for many years because of the persistent symbiotic relationship between middlemen and fishers. Since middlemen had always been an easy source of loan for fishers thus, fishers are obliged to sell their catch to the middlemen.

Due to their inadequate facilities, fishers are unable to preserve large quantities of fish during fishing trips or transport their catch on land as often as necessary because of the high cost of fuel. This is another aspect where middlemen's role comes in handy by helping fishers in preserving and transporting their catch. Moreover, fishers who are inadequately educated are oftentimes not capable of transacting business with big companies because of the seemingly complicated documentation and other administrative works.



A primary middleman from Khanh Hoa Province, Vietnam contented after the fishers' windfall of good anchovy catch

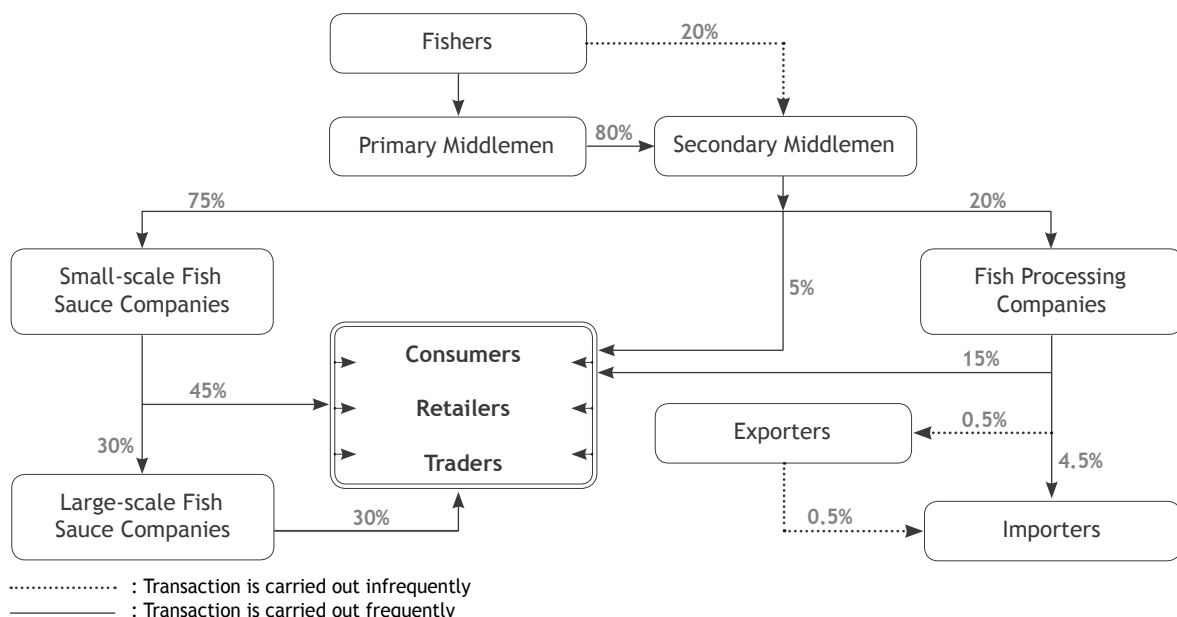


Fig. 2: Value chain of anchovy products in Khanh Hoa Province, Vietnam

Fish processing companies including those engaged in freezing, drying and steaming fish products for export and for sale in domestic markets require large quantities of anchovies to be used as raw materials for processing. Anchovies are collected from various sources such as from middlemen, fishing vessel owners and traders, making the value of the anchovy products increase by several folds during the various stages of product transformation. In Khanh Hoa Province, fish sauce companies are mostly owned by private companies and produce fish sauce mainly for the domestic market as it is the country's traditional ingredient for local cuisine, while only few countries are using fish sauce in their culinary.

Nevertheless, the survey also unraveled that 584 joint stock companies had been marketing small quantities of fish sauce abroad while many fish product exporters also use fish sauce as ingredients for their value-added products. For instance, it was also discovered that large-scale fish sauce companies in Vietnam which include a big corporation producing popular brands of fish sauce, usually buy fish sauce from small companies to be transformed using their own technology into enhanced fish sauce products and sold in markets.

Although their involvement in the value chain of anchovy products is considered minimal, export traders still exist because some private processing companies are sometimes unable to export their products. The exporters' role in the chain is therefore mainly in facilitating transactions especially in terms of transporting and distributing anchovy products to importers. However, exporters are not involved in the production or in the transformation of the products. Importers that comprise the last stakeholders in the value chain for anchovy products are mainly from Korea and Japan.

Competitiveness among anchovy stakeholders in the value chain

Fishers: A number of anchovy fishing vessels are operating in Khanh Hoa Province, Vietnam although it was reported that the number of anchovy fishing vessels had decreased since 2005. While this is a good sign for the sustainable exploitation of the anchovy resources but it is necessary to establish the reasons for such reduction since the anchovy fishers could be back to fishing any time. While the investment cost for a new fishing boat is not as expensive as that of an offshore vessel, but in most anchovy fishing boats preservation facilities are insufficient. Moreover, some fishers have also been reported to use destructive methods resulting in low quality of their catch and consequently in decreased competitiveness of the anchovy products (Khanh Hoa DECAFIREP, 2009).

Intermediaries: For the middlemen, the entry barriers are very difficult to hurdle especially for secondary middlemen.



Families of fishers anxiously waiting for fishing vessels to return to shore and hoping for good anchovy catch

Firstly, fishers would have difficulties with their fishing operations without obtaining loans from middlemen who have the financial resources and are willing to provide the needed capital to fishers. Moreover, it would be difficult for new entrants in the middlemen system because of the close relationship between fishers and current middlemen that had already been well established. This linkage makes the middlemen the most effective and highly competitive intermediaries in the value chain. However, in the entire value chain such effectiveness and competitiveness could be short run only as it seems unsustainable in the long run. The middlemen's operations are usually unprompted and orchestrated by private persons without any involvement from the government especially in the management aspects. This situation often leads to unfair distribution of the benefits among stakeholders resulting in some forms of hostility. Furthermore, such differences could influence the production processes and end products that are not in accordance with the standards making it difficult for the products to hurdle the strict commercial barriers in food safety and traceability, and subsequently to the shrinking market of the products.

Fish processing companies: Anchovy products are among the major export commodities of many Asian countries with Vietnam leading the group of exporting countries worldwide. However, the competitiveness in processing is still low because operations are usually small-scale, even if value-adding of the products for export had considerably increased during the recent years. Initiatives to increase the competitiveness of the processing companies could not be sustained because most companies are less concerned of the origin of the raw materials as well as on traceability, and are unable to comply with the food safety requirements of the market. This concern should be addressed in order to improve the competitiveness of the anchovy products in the value chain.

Fish sauce companies: Producing fish sauce has been a traditional undertaking in Vietnam, using processes that involve simple techniques and less investment costs. However, no new companies have recently entered or joined the business mainly because of the existing habit of Vietnamese consumers to use only brand named fish sauce making it difficult for new fish sauce products to gain the confidence of consumers. Although almost every Vietnamese know the processes of making fish sauce, but producing quality fish sauce as a traditional food industry that needs much experience and skills (know-how that had been accumulated in many years or inherited from generations). Nevertheless, the recent entry of the big corporation into the fish sauce industry has become an obstacle for many other small-scale fish sauce companies, considering that the financial status of the corporation is in very good condition and their fish sauce products are becoming more and more available in all segments of the domestic market because of the professionalism in their marketing system. This corporation also avails of the media to continuously market their products and adds personal touch in marketing by approaching prospective consumers every day to demonstrate the quality of their fish sauce. The entry of the corporation into the industry is expected to affect the profitability of other fish sauce companies to the extent of bringing new entrants to the verge of bankruptcy in short run as well as the present companies in the long run. The information provided by fishers during the interview indicated that the anchovy resource in Vietnam had been decreasing in recent years, and is likely to remain unstable because of the changing weather conditions. In fact, many fish sauce companies are now faced with constraints on the erratic availability of raw materials (anchovy catch) for processing. Therefore, sufficient supply of anchovy should be ensured for the sustainability of the fish sauce industry of Vietnam.

As indicated in **Fig. 3**, importers mainly determine the price of anchovy products for export, which is very common in Vietnam since the country has weak position in the global chain. However, the intensity of the importers' decision in imposing the price of dried anchovy is not as strong as for frozen anchovy because frozen products can be preserved for a long time while the shelf life of dried anchovy is quite short. Meanwhile, since the demand for anchovy products as raw

materials for other value-added products has been increasing, fish processing companies have taken advantage of such situation to bargain for higher price with the importers. In a way, fish sauce companies have also the clout in determining the price of anchovy products. Nevertheless, such trend of influence could change between middlemen and fish sauce companies depending on the season of anchovy catch. Specifically, the bargaining power moves from middlemen to fish sauce companies during the high season and *vice versa* in the low season.

Market Conduct

As shown in **Fig. 4**, the fishers are always the lowest price takers for they have almost no power to determine the price of their catch for lack of sufficient information about the value of their catch. Being financially indebted to the middlemen who are their most dependable source of loan for their fishing operations, more often than not, fishers sell their catch at night although the selling price is confirmed only until the following morning. This situation enables the middlemen to dictate low market price for the anchovy catch with the knowledge of fishers who are not in the position to negotiate for higher price because they do not have the facilities to preserve large quantity of anchovy catch overnight.

Market Performance

Nonetheless, the results of the study (**Table 3**) also suggest that most of the economic benefits are gained by the first stakeholders (fishers) and the last stakeholder (fish processing/ fish sauce companies) of the value chain. In spite of the aforementioned factors that seem to favor the fishers' economic conditions, fishers are still considered as among the poorest in the economy while middlemen are rather the wealthier groups. Meanwhile, in terms of market and utilization, the maximum economic benefit goes to stakeholders involved in distributing anchovy for export, followed by stakeholders in the anchovy domestic market, and stakeholders in the anchovy as raw materials for fish sauce.

Finally, as shown in **Tables 4.1 to 4.3**, it appears that the middlemen seem to obtain the least benefits in the value chain

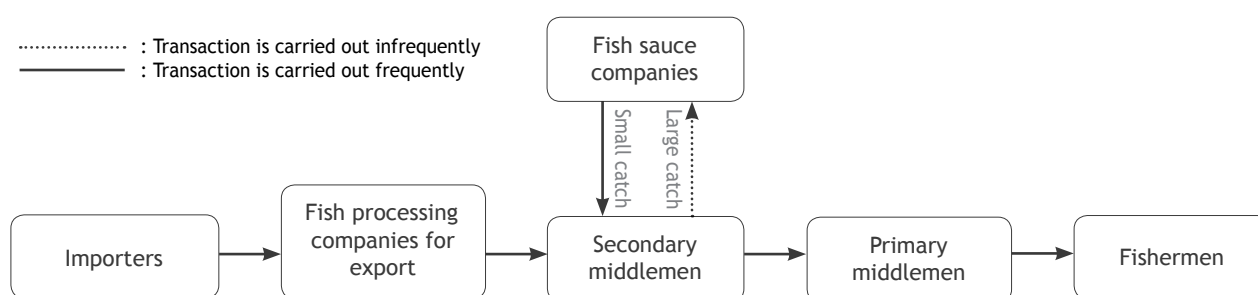


Fig. 3. Price formation process of anchovy products

Table 3. Distribution of cost and profit in the value chain of anchovy products (USD 1.00 = VND 20,610¹)

Criteria	Unit	Anchovy for export		Anchovy for domestic market		Anchovy for fish sauce	
		Value	Rate	Value	Rate	Value	Rate
1. Fishers							
Total cost	VND/kg	4,578	11.12	4,578	27.47	4,578	22.89
Operating cost per trip	VND/kg	1,752		1,752		1,752	
Labor cost	VND/kg	1,999		1,999		1,999	
Depreciation + maintenance	VND/kg	804		804		804	
Interest	VND/kg	23		23		23	
Marginal profit	VND/kg	15,422	37.46	5,422	32.53	(78)	(0.39)
Output price	VND/kg	20,000		10,000		4,500	
2. Primary middlemen							
Input price	VND/kg	20,000		10,000		4,500	
Total cost	VND/kg	300	0.73	300	1.80	300	1.50
Operating cost per trip	VND/kg	250		250		250	
Depreciation cost	VND/kg	50		50		50	
Output price	VND/kg	22,000		11,000		5,000	
Marginal profit	VND/kg	1,700	4.13	700	4.20	200	1.00
3. Secondary middlemen							
Input price	VND/kg	22,000		11,000		5,000	
Total cost	VND/kg	350	0.85	350	2.10	350	1.75
Transportation/transaction costs	VND/kg	300		300		300	
Depreciation cost	VND/kg	50		50		50	
Output price	VND/kg	24,000		12,000		5,500	
Marginal profit	VND/kg	1,650	4.01	650	3.90	150	0.75
4. Fish processing-related companies							
4.1 Fish processing companies - for export							
Input price/kg materials	VND/kg	24,000					
Total cost/kg materials	VND/kg	6,667	16.19				
Production costs	VND/kg	5,833					
Transportation/transaction costs	VND/kg	167					
4.2 Fish processing companies - for domestic market							
Input price/kg materials	VND/kg			12,000			
Total cost/kg materials	VND/kg			3,667	22.00		
Production costs	VND/kg			3,333			
Transportation/transaction costs	VND/kg			167			
Depreciation cost	VND/kg			167			
Output price/kg materials	VND/kg			16,667			
Marginal profit	VND/kg			1,000	6.00		
4.3 Fish sauce companies							
Input price/kg materials	VND/kg					5,500	
Total cost/kg materials	VND/kg					14,000	70.00
Labor costs	VND/kg					10,060	
Packing costs	VND/kg					1,500	
Transportation/transaction costs	VND/kg					1,275	
Depreciation cost	VND/kg					1,165	
Output price/kg materials	VND/kg					20,000	
Marginal profit	VND/kg					500	2.50

Source: calculated from survey data, 2010

¹ Exchange rate in July 2010

Table 4.1. Distribution of economic value among stakeholders in the value chain of anchovy products for export
(Unit: %: USD 1.00 = VND 20,610)

Stakeholders Indicators	Fishers	Primary Middlemen	Secondary Middlemen	Fish processing company - for export
1. Value added				
Output price (VND)	20,000.00	22,000.00	24,000.00	41,167.00
Value added	48.58	4.86	4.86	41.70
2. Created value				
Marginal profit/total cost	336.87	8.37	7.38	34.24
Marginal profit/incremental cost	336.87	566.67	471.43	157.50

Source: calculated from survey data, 2010

Table 4.2. Distribution of economic value among stakeholders in the value chain of anchovy products for domestic market
(Unit: %: USD 1.00 = VND 20,610)

Stakeholders Indicators	Fishers	Primary Middlemen	Secondary Middlemen	Fish processing company - domestic market
1. Value added				
Output price (VND)	10,000	11,000	12,000	16,667
Value added	60.00	6.00	6.00	28.00
2. Created value				
Marginal profit/total cost	118.44	6.80	5.73	6.38
Marginal profit/incremental cost	118.44	233.33	185.71	27.27

Source: calculated from survey data, 2010

Table 4.3. Distribution of economic value among stakeholders in the value chain of anchovy products for fish sauce
(Unit: %: USD 1.00 = VND 20,610)

Stakeholders Indicators	Fishers	Primary Middlemen	Secondary Middlemen	Fish sauce Company
1. Value added				
Output price (VND)	4,500	5,000	5,500	20,000
Value added	22.50	2.50	2.50	72.50
2. Created value				
Marginal profit/total cost	-1.70	4.17	2.80	2.56
Marginal profit/incremental cost	-1.70	66.67	42.86	9.09

Source: calculated from survey data, 2010

Table 5. Estimates of the average income of stakeholders in the value chain of anchovy products

Stakeholders	Sample size	Marginal profit (VND/kg)	Quantity (kg)	Income (VND)
1. Fisherman	46		103,417	157,400,674
From anchovy for export		15,422	5,171	79,744,849
From anchovy for domestic		5,422	15,513	84,109,046
From anchovy for fish sauce		(78)	82,734	(6,453,221)
2. Primary middleman	2	200	2,000,000	400,000,000
3. Secondary middleman	1	150	5,000,000	750,000,000
4.1 Fish processing company - for export	1	10,500	1,000,000	10,500,000,000
4.2 Fish processing company - for domestic market	2	1,000	2,000,000	2,000,000,000
4.3 Fish sauce company	3	500	2,000,000	1,000,000,000

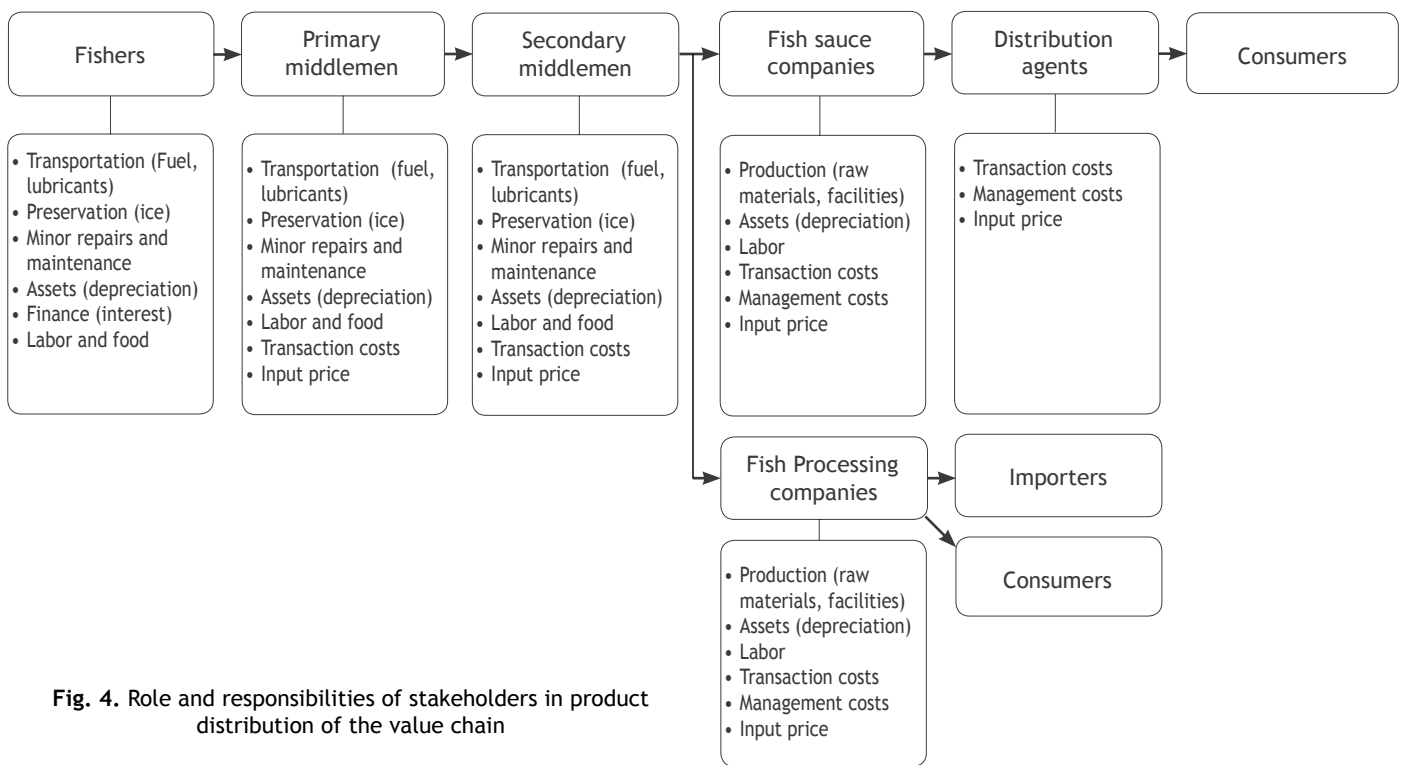


Fig. 4. Role and responsibilities of stakeholders in product distribution of the value chain

of anchovy products. Nevertheless, if the total income is taken into consideration (**Table 5**), the highest economic benefit goes to the last stakeholder in the value chain (fish processing companies, fish sauce companies). More specifically, the fish processing companies producing anchovy products for export would get the highest income because as the raw materials are transformed to high-value products the value along the chain could increase in several folds. Nevertheless, these companies could also encounter some risks especially when the strict requirements for food safety, traceability and certification of marine fishing products, are not complied with. The second highest benefit goes to the middlemen. Although the contribution of middlemen in terms of value adding and profit could be lower than the other stakeholders in the value chain, their output price is determined by importers as well as domestic producers, and thus, have the advantage of collecting large volumes of fish from the fishers and as a result, their total income could be very high.

The least benefits go to the fishers. Fishing is a very risky job and the price of fish catch depends entirely on the behavior of importers and domestic producers. Meanwhile, middlemen seem to have no risks at all because transactions are carried out based on the principle that input price is formulated from the output price. Therefore, fishers usually take more risks than the other stakeholders because fishing operations could be influenced by the weather conditions. Moreover, the market rule in supply and demand is: the more the fish, the lower is the price.

Policy Implications

The bottom line is fishers get the least benefits in the value chain in spite of the high risks that they have to face during the fishing operations. Therefore, policies should be developed that would aim to give more support to fishers. The proposed policy recommendations for the three types of anchovy products are shown in **Box 2**. Moreover, additional policies are also proposed to improve the benefits of all stakeholders in the value chain for different types of anchovy products as indicated in **Box 3**.

Conclusions

In a highly competitive fisheries industry worldwide, cooperation in the value chain of fish and fishery products should be considered as a vital tool for sustainable fisheries development, which should also be considered for the sustainability of anchovy fisheries in Khanh Hoa Province, Vietnam considering the economic importance of the fishery to the country's economy (Nguyen Thi Tram Anh, 2009). Enhancing the cooperation along the value chain of the fish products not only offers opportunities for the stakeholders to improve their competitiveness in the chain but also creates potential improved benefits that could be gained along the chain. Therefore, it is important to build up the necessary institutions for developing such cooperation in the value chain. Nonetheless, local authorities should also provide constructive solutions to support the fishers to ensure that equal benefits also go to them as with the other stakeholders.

Box 2. Proposed policy recommendations for all three types of anchovy products

- Provide the necessary legal frameworks such as regulations, requirements and standards to all stakeholders involved in the value chain in order that the quality of their products is ensured while food safety is assured for the sake of the consumers, and that the environment is protected in all stages in the value chain for the benefit of the future generations. Regulations to be established by the government should be specific enough for all stakeholders to easily cooperate and agree with the conditions, and should target the increased cooperation between relevant authorities and stakeholders in order to fulfill the requirements of consumers.
- Establish credit systems for fishers to reduce their dependence on middlemen for their financial requirements in fishing and eventually minimize the market power of middlemen on the price of their catch. As noted from the interview, fishers have difficulties in accessing loans from other sources in view of the strict requirements in terms of collaterals.
- Provide the necessary support in terms of technologies to fishers to enable them to preserve their catch in the most economical way. At present, fishers could not preserve their catch for a long period of time due to inadequate preservation equipment onboard fishing boats. For this reason, fishers usually sell their catch immediately to middlemen even if the agreed price is not confirmed, giving the power to bargain for the price to the middlemen.
- Develop an agricultural insurance system to be applicable to fishers to reduce their worries about the future of their families while they undertake the very risky fishing operations.
- As for the sustainable development of fisheries, intensify campaigns to strictly prohibit the use of destructive fishing methods, adopt closed seasons or areas as and when necessary to protect the spawning and nursing areas of many marine aquatic species. During the interview, many fishers indicated that approximately 75% of anchovy must be sold to fish sauce processing companies immediately upon landing. One of the reasons given was the diminishing quality of the anchovies that might have been harvested using destructive fishing means such as “nghe pha xuc”. Fishers should therefore be encouraged to move away from adopting the “nghe pha xuc” towards purse seine fisheries to ensure the quality of anchovy catch.

Box 3. Policies to improve the benefits of stakeholders in the value chain of anchovy products

Anchovy for export: In order to increase the competitiveness of the exporters and other stakeholders in the value chain, the following approaches should be considered: (1) collaborative mechanism should be developed in the production, purchasing and selling of the products through some forms of fishing cooperatives or production groups in order to ensure that traceability could be carried out (Nguyen Thi Tram Anh and Huynh Phan Thuy Vi, 2010); (2) information dissemination should be intensified especially on the various commercial/ technological barriers employed widely making sure that all stakeholders can access to such information; (3) use of log books should be promoted while purchasing of products without knowing their origin must be avoided, and compliance of international regulations and requirements by stakeholders especially the fish processing companies must be supervised and supported by appropriate government authorities; (4) regulations that aim to limit and stop exporting immature anchovy should be formulated to ensure sustainable development of the fishery; and (5) government and local authorities to continuously compile relevant information from international markets to diversify risks and avoid the pressure of imposing low price on the fishery products.

Anchovy for domestic market: Although this product is mainly for local consumers and tourists, requirements on quality could not be as strict as that for products meant for the export market. Nevertheless, local authorities should supervise the operations of relevant companies to ensure that these fulfill food safety and traceability for the maximum benefits of consumers.

Anchovy for fish sauce: To ensure enhanced benefits of consumers and promote fair competitiveness among producers, government authorities should make efforts to: (1) impose strict and clear discipline on companies in fulfilling the requirements for quality; and (2) support the fish sauce industry by seeking for more distribution markets for their products.

References

- Euromonitor International. *www.marketresearch.com* accessed in August 2011
- Khanh Hoa DECAFIREP. 2009. Report of registered fishing vessels and their capacities in 2008 and 2009
- Krishnan, M., Narayanakumar, R. 2010. Structure, Conduct and Performance of Value Chain in Seaweed Farming in India. *Agricultural Economics Research Review*. Vol. 23, pp. 505-514
- Nguyen Thi Tram Anh, Huynh Phan Thuy Vi. 2010. Access Supply Chain to Improve Competitive Advantage for White Shrimp - Case in Nha Trang Seafoods Joint Stock Company F17. *Science and Technology Journal, Da Nang University*. Vol 5(40), pp. 286-295
- Nguyen Thi Tram Anh. 2009. Value Chain Cooperation in Fisheries Products – A Tool to Increase Khanh Hoa’s Fisheries Exports in Globalisation. *Fisheries Science and Technology Journal, Nha Trang University*. Vol 4, pp. 84-89
- SEAFDEC. 2002. Fishing Gear and Methods in Southeast Asia: IV. Vietnam. *Southeast Asian Fisheries Development Center – Training Department, Samut Prakan, Thailand*; 277 p
- SEAFDEC. 2012. The Southeast Asian State of Fisheries and Aquaculture 2012. *Southeast Asian Fisheries Development Center, Bangkok, Thailand*; 130 p
- Trondsen, T. 2003. Criteria and Methodology to Improve the Effects of International Trade on Food Security in Fish-Exporting and Fish-Importing Developing Countries. *In: Report of the Expert Consultation on International Fish Trade and Food Security*. FAO Fisheries Report No. 708, pp. 87-102

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JSPS Asia-Africa Science Platform Program: Brief summary of first year activities

Katsutoshi Arai, Junichiro Okamoto, Nobuo Kimura, Yasuaki Takagi, Kunihiko Konno, John Bower, and Virgilia Sulit

Hokkaido University is now leading a three-year project that aims to establish a research and educational network and platform to assist young researchers in developing sustainable fisheries production and advanced utilization of fisheries products in Southeast Asia, and to internationalize higher education in fisheries. This paper summarizes the main activities of the program during the first year of its implementation.

Under the Asia-Africa Science Platform (AASP) Program, the Japan Society for the Promotion of Science (JSPS) sponsors three-year projects designed to contribute to the efforts in addressing a wide range of problems in Asia and Africa. In these projects, research institutions in Japan have been collaborating with those in Asia and Africa, to form research hubs that both implement the projects and foster young researchers from these regions.

The Hokkaido University's Faculty of Fisheries Sciences (HUFFS) is now leading the implementation of three-year (April 2011- March 2014) AASP project that aims to establish a research and educational network and platform to assist young researchers in developing and conducting research in the areas of sustainable fisheries production and advanced utilization of fisheries products in Southeast Asia, and to internationalize higher education in fisheries. The project

comprises five subjects, namely: fisheries policy, sustainable fisheries production, environment-friendly aquaculture, advanced fisheries-product utilization, and international higher fisheries education (**Box 1**).

Each subject comprises research and seminar activities, where research activities involve cooperative research, and where the concerned researchers exchange their findings through academic meetings among the participating institutions. Most research activities during the first year were conducted at HUFFS, while the seminars were held at the SEAFDEC Secretariat in Bangkok, Thailand and in the respective locations of the Departments.

The International Seminars

In order to provide a forum for sharing the results of research activities conducted under each subject, four seminars were held in late 2011 and early 2012 (**Box 2**).

Subject 1: Marine fisheries policy in Southeast Asia

To promote research on marine fisheries policy, fellowships were provided to one staff member from the SEAFDEC Secretariat and to two staff members from the SEAFDEC Training Department (HUFFS, 2012). *Ms. Sawitree*

Box 1. Subjects, team leaders and in-country partners and coordinators for the AASP project

Subject	HUFFS Team Leaders	In-country Partners	In-country Coordinators
Marine fisheries policy in Southeast Asia	Junichiro OKAMOTO	SEAFDEC Secretariat	Kenji MATSUMOTO
Sustainable production of fisheries resources in Southeast Asia	Nobuo KIMURA	SEAFDEC/MFRDMD	Mahyam Mohd ISA
	Takashi MATSUIISHI*		
Environment-friendly aquaculture and stock enhancement in Southeast Asia	Yasuaki TAKAGI	SEAFDEC/AQD	Joebert TOLEDO
Highly efficient utilization and processing of fisheries resources in Southeast Asia	Kunihiko KONNO	SEAFDEC/MFRD	Soon-Eong YEAP
Globalization of higher education of fisheries sciences in Southeast Asia	John BOWER	Kasetsart University	Nontawith AREECHON
			Wanchai WORAWATTANAMATEEKUL**
		Asian Institute of Technology	Wenresti GALLARDO

AQD: Aquaculture Department of SEAFDEC in Iloilo, Philippines

HUFFS: Hokkaido University, Faculty of Fisheries Sciences, Hakodate, Hokkaido, Japan

MFRD: Marine Fisheries Research Department of SEAFDEC in Singapore

MFRDMD: Marine Fishery Resources Development and Management Department of SEAFDEC in Kuala Terengganu, Malaysia

* Sub-leader

** Sub-coordinator

Box 2. Seminars held during the first year of the AASP project

Subjects	Location/Venue	Date
Marine fisheries policy in Southeast Asia	SEAFDEC Secretariat	21 February 2012
Globalization of higher education of fisheries sciences in Southeast Asia		
Sustainable production of fisheries resources in Southeast Asia	SEAFDEC/MFRDMD	15 December 2011
Environment-friendly aquaculture and stock enhancement in Southeast Asia	SEAFDEC/AQD	1 December 2011
Highly efficient utilization and processing of fisheries resources in Southeast Asia	SEAFDEC/MFRD	11 January 2012

Chamsai of the SEAFDEC Secretariat conducted research that aimed to enhance the management of fishery resources in Southeast Asia using lessons learned from the Japanese Fisheries Cooperative System. The results of the research included recommendations suggesting that devolution of legislative and policy directions as well as authority to the local government and fishers' organizations would enhance fisheries management in the Southeast Asian region. The development of legitimate definition of property rights and decision-making arrangements as well as appropriate local responsibilities and authorities should be carried out in the region while the establishment of a mechanism to facilitate the process of consultation and negotiation building upon the involvement of relevant stakeholders should also be focused.

Moreover, for sustainable fisheries management, community initiatives should be mainstreamed into national policies; self-reliance should be practiced considering the limited manpower and budget provided by governments; careful management of existing resources should be promoted taking into account the rapid human population growth in the region, changes in social structures, globalization, and increasing cost of living. In community-based resource management, enhancing the stakeholders' understanding of the elements of resilience and their adaptive capacity to the various drivers of change should be promoted.

However, considering the small-scale and multi-species nature of fisheries in Southeast Asia, the concept of cooperativism based on the Japanese fishery cooperative association (FCA)



SEAFDEC officers led by Secretary-General, Dr. Chumnarn Pongsri (*right*) and Deputy Secretary-General Mr. Kenji Matsumoto (*second from right*) during the International Seminar on Marine Fisheries Policy and Higher Education in Fisheries in Southeast Asia held at the SEAFDEC Secretariat in Bangkok on 21 February 2012

could not be readily applicable in the region if a sense of ownership of the fisheries is not yet institutionalized within the fishers groups.

Another study was conducted to create a better understanding of the demographic and social dynamics of coastal fishing communities that contribute to the development of policies for coastal resource use and conservation. *Ms. Sumitra Ruangsivakul* of SEAFDEC Training Department (TD) carried out a socio-economic study on coastal fisheries in Thailand, taking into consideration the current situation of small-scale fisheries in three coastal fishing areas and comparing these with those from other established fishing communities. The study adopted a two-prong survey approach (*i.e.*, interview with local officials and sample survey of households) in order to identify the common issues that could be used to improve



Participants in the International Seminar on Marine Fisheries Policy and Higher Education in Fisheries in Southeast Asia held at the SEAFDEC Secretariat in Bangkok, Thailand on 21 February 2012

small-scale fisheries policies that are based on national and local initiatives. Results of the analysis showed that most fishers seem to be unaware of the implications of IUU fishing but fishers understand the impacts of climate change on fisheries. The non-cognizant of fishers on the impacts of IUU fishing on fisheries contributed to their negative attitude and non-participation in enforcing the regulations on IUU fishing. Meanwhile, many fishers have not considered safety at sea as a priority issue, and in the sample areas fishers do not carry life-saving equipment onboard other than transistorized radio to monitor the weather condition of their fishing grounds. Many fishers however, recognized the need to adopt energy-saving in fisheries as means to reduce operations costs.

The development of a fishery information factsheet (FIF) for tuna fisheries management in Southeast Asia based on lessons learned in Japan was attempted by Ms. Namfon Imsamram of SEAFDEC/TD. Since FIFs have been used in Japan to support self-management of fisheries by FCAs and ensure sustainable fisheries operations, the possibility of introducing Japan's FIF system and management mechanism to fishers, policy makers and other stakeholders in the Southeast Asian region was explored to support sustainable fisheries management, initially focusing on neritic tuna fisheries in the Andaman Sea. However, it was noted that in order to adopt the FIF system, it is necessary for concerned countries to improve their systems of collecting tuna statistics, specifically the trend of tuna catch. Moreover, in order that the countries could adopt the FIF for tuna fisheries management in Southeast Asia, capacity building is necessary which could focus in the areas of population dynamics as well as on the development of relevant models for stock assessment including catch forecasting, bio-economics, and biometrics. Meanwhile, improving their respective fishery statistics collection systems is very crucial to enable the countries to carry out the necessary stock assessment analyses.

Subject 2: Sustainable production of fisheries resources in Southeast Asia

A research fellowship grant was awarded to Noorul Azliana J. of SEAFDEC/MFRDMD to conduct a study on the genetic identification of commercially-important pelagic fishes in the South China Sea and Andaman Sea. Through the study, she was able to acquire knowledge on the identification of selected fish species using molecular techniques, adoption of the polymerase chain reaction (PCR) process, sequencing techniques from the cytochrome b region of the mitochondrial DNA (mtDNA) of selected species, and analyzing the data obtained from the aforementioned techniques, and also in determining the phylogenetic relationships between selected species (HUFFS, 2011). For the study, 20 samples each of Indian mackerel (*Rastrelliger kanagurta*), short mackerel (*R. brachysoma*), round scad (*Decapterus macrosoma*), and horse mackerel or Japanese scad (*D. maruadsi*) were collected from the South China Sea and the Andaman Sea.

The DNA of the selected samples was analyzed for genetic variation using cytochrome b of mtDNA. The cytochrome b gene was amplified using PCR, and a 461 bp partial fragment of the gene was sequenced in 58 samples to determine the haplotype differences and phylogenetic relationship among the species. A total of 14 haplotypes were obtained in the *Rastrelliger* spp. and 8 in the *Decapterus* spp. From the phylogenetic tree constructed using the Neighbor-Joining (NJ) method, *R. kanagurta* and *R. brachysoma* could be differentiated as two different species.

However, the phylogenetic relationships among the *Decapterus* spp. could not be determined. While DNA degradation might have occurred during the long storage of the samples, genomic DNA was successfully amplified by the PCR method for all selected samples. The inability of the analysis to identify the

Participants in the International Seminar on Sustainable Production of Fisheries Resources in Southeast Asia held at the MFRDMD facilities in Kuala Terengganu, Malaysia on 15 December 2011



Ms. Noorul Azliana Binti Jamaludin (left) presenting the results of her research during the International Seminar on Sustainable Production of Fisheries Resources in Southeast Asia held at the MFRDMD facilities in Kuala Terengganu, Malaysia on 15 December 2011



Decapterus spp. suggests that morphological studies of the species should also be done along with the genetic analysis.

Therefore, a molecular study using nuclear DNA or microsatellites as other markers should also be conducted in the future, for the proper identification of various fish species. Nevertheless, the study proved the importance of genetic identification for taxonomy validation in addition to the morphology analysis of the species.

Subject 3: Environment-friendly aquaculture and stock enhancement in Southeast Asia

The populations of important endemic fish species in Philippine waters have been dwindling due to excessive fishing by local fishers. Silver therapon *Leiopotherapon plumbeus* (Kner, 1864) is an endemic freshwater fish that can be caught in Laguna de Bay, Philippines, and in order to conserve this fish resource, hatchery techniques should be developed for culture purposes. Hence, knowledge on the morphological development, growth, and suitable live foods for the first-feeding larvae is important to develop effective hatchery techniques and feeding regimes. Previous rearing trials of silver therapon ended with high mortalities four days after hatching (DAH).

Thus, a study was conducted by *Dr. Frolan Aya*, a research fellow from AQD to characterize the developmental changes in the morpho-anatomical traits of the silver therapon, in order to better understand the larval development of the fish focusing on the feeding apparatus (*i.e.*, mouth gap size) and the rate of growth, the ways of predicting the initial time of feeding, and the developmental stages of the larvae based on histological studies. Samples of silver therapon larvae from 0 to 4 DAH collected from hormone-induced spawning trials showed that the average growth rate calculated from total length measurements was 0.124 mm/day. The time for initial feeding of silver therapon larvae was predicted at 2 DAH (total length of 2.15 mm) based on oil globule and yolk volume measurements. The mouth gap size of the larvae was 0.139 ± 0.027 mm at first-feeding (2 DAH) and increased to 0.221 ± 0.050 mm at 4 DAH. Sections of the larvae confirmed

that yolk reserves were used up at 2 DAH, the pancreas and liver were not well-developed, and looping intestines had been noted. The kidney started to develop at 3 DAH, and at 4 DAH, cells were observed to have vacuoles, indicating that the cells had been inactive and in the dying state. Based on these preliminary results, the larval food appropriate for the mouth gap size of the fish larvae will be investigated to develop a feeding regime for larval rearing of this species.

Another research fellow from AQD *Dr. Maria Michelle Peñaranda* carried out a study on the partial purification of carrageenase from a Philippine seaweed bacterial isolate at the Laboratory of Marine Biotechnology and Microbiology at HUFFS from 22 August to 26 September 2011. Strain improvement of commercially-important seaweeds (*i.e.*, disease-resistant and fast-growing) and production of quality seedstocks have been considered as means of addressing one of the major concerns of the seaweed industry in the Philippines. One method of improving the strain of seaweeds is by somatic hybridization via protoplast fusion, which permits the rapid development of new strains and the transfer of genes and traits between species. SEAFDEC/AQD has been successful in the isolation of protoplasts for some *Kappaphycus* sp. and significant efforts are continuously being made to isolate and culture protoplasts from other species of red seaweeds. However, compared with the protoplasts of other seaweeds that can be obtained using commercially-available cellulases alone, the red seaweeds require other enzymes such as agarases and carrageenases, the latter of which are not commercially available and are expensive to produce. In this regard, the possibility of using polyssacharidases to isolate the protoplasts of a variety of commercially-important red seaweeds had been explored.

Moreover, another research fellow from AQD *Ms. Ellen Grace Tisuela* learned at HUFFS the technical methodologies for cytogenetic studies on hybridization and polyploidization of abalones. The technique included preparation of chromosome slides for karyotyping analyses using the abalone *Haliotis discus hannai* from Kumaishi Hatchery in Japan. The chromosome slides were prepared using air (flame)-dry method to improve the cytogenetic results. Well-done spreads

Participants in the International Seminar on Environment-friendly Aquaculture and Stock Enhancement in Southeast Asia held at the AQD facilities in Tigbauan, Iloilo, Philippines on 1 December 2011





Ms. Ellen Grace Tisuela presenting the results of her research during the International Seminar on Environment-friendly Aquaculture and Stock Enhancement in Southeast Asia held at the AQD facilities in Tigbauan, Iloilo, Philippines on 1 December 2011

of the metaphase was obtained, and the chromosomes were distinct enough for microscopic observation. Secondly, the DNA content in the cell nucleus was measured using a Partec flow cytometer.

As a rapid and easy method to identify triploid and hybrid individuals, the gill tissue and epipoidal tentacles were sampled from the abalone, and stained with DAPI solution and read using a Partec flow cytometer. Another technique introduced during the training was on the preparation of samples for histological analyses, which comprised: 1) placing the cells in paraffin wax; 2) slicing thin sections; and 3) putting the sections on glass slides. After washing in different staining solutions, the samples were ready for microscopic viewing. This histological technique is important to assess the reproductive capacity of hybrid and triploid individuals.

Subject 4: Highly efficient utilization and processing of fisheries resources in Southeast Asia

After the international seminar at MFRD and as a follow-up on this activity, the Chief of MFRD visited HUFFS in late February 2012 to gain a better understanding of the research work and discuss the details of the collaborative research



Participants in the International Seminar on Highly Efficient Utilization and Processing of Fisheries Resources in Southeast Asia held at the premises of MFRD in Singapore on 11 February 2012

program between HUFFS and MFRD. This was intended to help MFRD select a prospective research fellow for the AASP, and decide on an appropriate research area to be conducted under the research fellowship (SEAFDEC, 2012).

Subject 5: Globalization of higher education of fisheries sciences in Southeast Asia

In order to promote international higher education in fisheries in Southeast Asia, two exchange research fellows from Thailand were granted fellowships to conduct studies aimed at evaluating the internationalization of higher education in fisheries in Southeast Asia (HUFFS, 2012). The studies have been considered very timely, especially that the ASEAN Economic Community (AEC) which is expected to be achieved by 2015, will result in the free flow of skilled labor including experts in the ASEAN region. Therefore, universities will need to ensure that their graduates can compete in the education market with the regional supply of highly qualified experts.

An internationalization survey was conducted by *Ms. Sirisuda Jumnongsong* of Kasetsart University involving faculty members and students from several universities and institutions of learning in Thailand as respondents. The survey required the respondents to assess the importance, rationale, benefits, and risks of internationalization at their respective universities and institutions. In July 2012, a similar study was conducted at the University of the Philippines in the Visayas (Miag-ao, Iloilo, Philippines) College of Fisheries and Ocean Sciences, and the study will be expanded in 2013 involving another ASEAN member state.

For the Asian Institute of Technology (AIT) which is a leading postgraduate institution in the Asia-Pacific region promoting technological changes and sustainable development through higher education, research and outreach programs, research fellow *Dr. Wenresti Gallardo* emphasized that in the course of implementing graduate programs, AIT has been confronted with various problems and challenges. Considering that AIT students come from many countries in the Asia-Pacific region, some students have poor English communication skills, especially those coming from universities where English is not the medium of instruction. To address this concern, it has become a challenge for AIT to teach its students using English, although applicants for graduate programs at AIT are now screened using certain criteria, *i.e.* applicants should have an average score of 4.5 based on the International English Language Testing System (IELTS) to enter a master's degree program and an IELTS score of 5.5 for the doctoral degree program.

In addition, AIT also offers English courses to students while they are taking their respective academic courses. Nevertheless, considering that there had been a recent steep decline in financial support received by AIT in terms of scholarships, AIT had to intensify its campaign to secure scholarships for deserving students, welcome more self-supporting students, raise funds for salaries and operating expenses, and promote the establishment of public-private partnerships. This concern has emanated from the fact that the original charter of AIT seemed ambiguous. AIT was legally declared as an international organization under a revised charter, so it is now able to seek sources of financial support from abroad, and extend cooperation and support from other international institutions of higher learning. Thus, internationalization of higher education is also being sustained especially in sciences.

Way Forward

As one of the pillars of the ASEAN regional integration, the ASEAN Economic Community (AEC) aims to develop a single market and production base, competitive economic region with equitable economic development, and a region fully integrated into the global economy by 2015. Achieving a single market and production base means that there will be a free flow of goods, services, investment, skilled labor, and capital. Since the education environment has been continuously changing, the ASEAN countries must enhance their respective education systems to adapt to such changes and to go along with the AEC Blueprint. In the past, most graduates worked in their home countries, but today graduates must prepare to work outside their home countries in a multi-cultural setting. Therefore, educational institutions must adapt to these changing conditions and create programs that fit the needs of the market at regional and global levels, which now focus on “open market”.

For educational institutions to better respond to global changes and adjust to this changing environment, they should have foresight on the changes that are happening. More specifically, information should be processed and used for data analysis (*e.g.*, probability statistics, decision analysis), collaboration with other sectors should be enhanced, new teaching technologies should be adopted (*e.g.*, electronic readers, video lectures/conferencing), more active learning classrooms should be created, and cosmopolitanism (an idea that all humanity belongs to a single community) should be promoted.

Similarly, research institutions dealing with marine sciences must be able to address the emerging issues that now prevail including those on marine ecosystem conservation and stable

seafood production to supply the growing populations and alleviate poverty, especially in Southeast Asia. It is also important for these institutions to stand together for sound and sustainable utilization of marine resources in the region. Thus, the paradigm now in fisheries science of “sustainability” in all aspects of research, education, international exchanges and academia-government-industry collaboration should be adapted by these educational institutions. One of the goals of the AASP program is also to contribute to the realization of the AEC, especially in the aspect of education in marine sciences.

References

- HUFFS. 2011. Proceedings of the International Seminar on Sustainable Production of Fisheries Resources in Southeast Asia (S-2), SEAFDEC/MFRDMD, Kuala Terengganu, Malaysia, 15 December 2011; 47 p
- HUFFS. 2012. Proceedings of the International Seminar on Marine Fisheries Policy and Higher Education on Fisheries in Southeast Asia (S-1), SEAFDEC Secretariat, Bangkok, Thailand, 21 February 2012; 78 p
- SEAFDEC. 2012. Asia-Africa Science platform program (AASPP) of Hokudai and MFRD. *In*: SEAFDEC Newsletter Vol. 35 No. 1 (January-March 2012). Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 13

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CALENDAR OF EVENTS

Date	Venue	Title	Organizer
2012			
7-15 August	Busan, Korea	8 th Regular Session of the Scientific Committee of the Western Central Pacific Fisheries Commission (WCPFC)	WCPFC
13-17 August	Philippines	Training Course on Freshwater Prawn Hatchery & Pond Grow-out Operations	AQD
27-28 August	Sri Lanka	7 th Meeting of the Technical Advisory Committee of the Bay of Bengal Programme - Inter Governmental Organization	BOBP-IGO
28-29 August	Phuket, Thailand	2 nd Andaman Sea Meeting	SEAFDEC-Sida
28-30 August	Nha Trang, Vietnam	3 rd ASEAN Tuna Working Group Meeting	ASEAN
4-6 September	Newfoundland, Canada	Inception of the "Too Big to Ignore" Project	Too Big to Ignore Project
10-12 September	Jakarta, Indonesia	ASEAN-ROK Network on Climate Change Adaptation in Aquaculture and Fisheries (Institutionalization Phase): Regional Consultation Workshop	ASEAN Secretariat
10-14 September	Penang, Malaysia	Inception Workshop for the Aquaculture for Food Security, Poverty Alleviation and Nutrition (AFSPAN) Project	FAO
11-12 September	Bangladesh	8 th Meeting of the Governing Council of the BOBP-IGO	BOBP-IGO
17-21 September	Philippines	Training Course on Carp Hatchery & Grow-out Operations	AQD
17-22 September	Da Nang, Viet Nam	32 nd Session of APFIC & 4 th Regional Consultative Forum Meeting	APFIC
24-28 September	Thailand	Regional Training Workshop on Habitat Mapping	TD
24 September	Palembang, Indonesia	International Conference on Inland Fisheries	Indonesia
27 September	Vientiane, Lao PDR	2 nd ASEAN AMAF Private Sector Partnership Dialogue	ASEAN
8-12 October	Da Lat, Vietnam	24 th Session of the Asia and Pacific Commission on Agricultural Statistics	APFIC
8-12 October	Philippines	Training Course on Freshwater Prawn Hatchery & Pond Grow-out Operations	AQD
8-16 October	Thailand	Regional Training Course on Post-harvest Fish Handling Techniques	TD
9-11 October	Bangkok, Thailand	FAO/APFIC/NACA Regional Consultation on Sustainable Intensification of Aquaculture in the Asia-Pacific	FAO/APFIC/NACA
11-12 October	Manado, Indonesia	43 rd Colombo Plan Consultative Committee Meeting	Colombo Plan
15-19 October	Philippines	Training Course on Catfish Hatchery and Grow-out Operations	AQD
16-18 October	Nha Trang, Vietnam	Workshop on Assessment of the Impacts of IUU Fishing and EC Regulation 1005/2008 on Small-scale Fisheries in the Southeast Asian Region	Vietnam, RPOA, SEAFDEC, and Singapore
29-30 October	Thailand	<i>Ad-hoc</i> Expert Meeting on the Selected Commercially-exploited Aquatic Species	Secretariat
31 October-2 November	Thailand	Regional Technical Consultation on International Fisheries-related Issues including the CITES Issues	Secretariat
6-8 November	Cambodia	9 th Meeting of the ASEAN Expert Group on CITES (AEG-CITES)	ASEAN
7-8 November (Tentative)	Singapore	Mid-Term Project Review Meeting for JTF Project on Traceability Systems for Aquaculture Products in the ASEAN Region	MFRD
12-14 November	Dubai, UAE	Summit on the Global Agenda 2012	World Economic Forum
12-30 November	Philippines	Training Course on Freshwater Aquaculture	AQD
26-28 November	Chiangmai, Thailand	35 th Meeting of SEAFDEC Program Committee	Secretariat-MFRD
29-30 November	Chiangmai, Thailand	15 th Meeting of the Fisheries Consultative Group of the ASEAN-SEAFDEC Strategic Partnership (FCG/ASSP)	Secretariat

Southeast Asian Fisheries Development Center (SEAFDEC)

What is SEAFDEC?

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

Mandate

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

Objectives

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

SEAFDEC Program Thrusts

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



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The first prize drawing winner from the national drawing contest in Indonesia

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