Purse Seine Fisheries in Southeast Asian Countries: A Regional Synthesis

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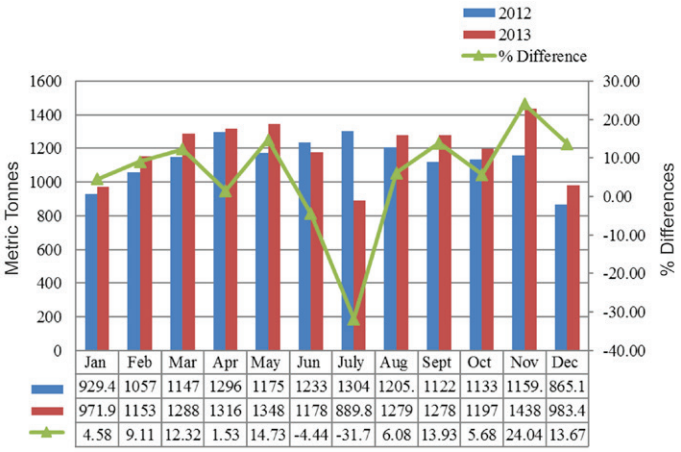
Several Southeast Asian countries, namely: Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Thailand, Philippines, and Viet Nam surround the South China Sea (SCS) which is one of the most important fishing areas for these coastal states, and where some of its fishery resources form shared stocks among these bordering countries. SCS encompasses a portion of the Pacific Ocean stretching roughly from Singapore and the Strait of Malacca in the Southwest, to the Strait of Taiwan (between Taiwan and China) in the northeast. The hydrography of SCS consists of continental shelf of 200 meters deep, continental slopes and deep waters down to more than 2,000 meters. In the SCS, small pelagic fisheries dominate by about 20% of the total marine capture fisheries. Living in the surface and mid-water column of ocean or inland ecosystem, pelagic fishes range in size from small coastal foraging fishes, such as herrings and sardines, to large apex predator oceanic fishes, such as the Southern Bluefin tuna and oceanic sharks. These pelagic fishes are usually agile swimmers with streamlined bodies, and capable of sustained cruising on long distance migrations. In many countries surrounding the SCS, purse seine has been commonly used to capture these pelagic fishes. The status of purse seine fisheries in the countries bordering the SCS is summarized in this article based on the information provided by the concerned countries and compiled by the SEAFDEC Marine Fishery Resources Development and Management Department (SEAFDEC/MFRDMD) during the Core Experts Meeting for Comparative Study on Purse Seine Fishery in the Southeast Asian Region organized by SEAFDEC/MFRDMD in Kuala Lumpur, Malaysia on 26-28 August 2014. The same information had also been reflected in a subsequent publication entitled "Current Status of Purse Seine Fisheries in the Southeast Asian Region" (SEAFDEC/MFRDMD, 2015). It should be noted that the term "South China Sea" is used in its geographical sense and does not imply recognition of any territorial claims within the area. A way forward to bring in long-term sustainable purse seine fisheries in Southeast Asia, more particularly in the SCS and Andaman Sea, is also being highlighted.

Based on FAO definition, purse seine is "made of a long wall of netting framed with floatline and leadline (usually, of equal or longer length than the former) and having purse rings hanging from the lower edge of the gear, through which runs a purse line made from steel wire or rope which allow the pursing of the net." FAO also claimed that "for most of the situation, purse seine is the most efficient gear for catching large and small pelagic species that is shoaling." In Southeast Asia, purse seines had been used since the nineteenth century, to catch pelagic fishes as alternative to trawl fishing targeting demersal fish stocks that had been declining. Earlier, the fisheries make use of various surrounding nets that had been modified into purse seines, and later, the use of commercial purse seines had been picked up by many countries in the region.

Discussed in the article is the development and status of purse seine fisheries in Southeast Asian countries that surround the South China Sea (SCS). Moreover, a way forward for long-term sustainable purse seine fisheries management in the South China Sea and Andaman Sea is also outlined based on the five-year project being carried out by the Marine Fishery Resources Development and Management Department (MFRDMD) of the Southeast Asian Fisheries Development Center (SEAFDEC). At the outset, it is crucial to take a look at the status of marine capture fisheries, especially purse seine fisheries in eight Southeast Asian countries that border the SCS area, namely: Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Thailand, Philippines, and Viet Nam.

Brunei Darussalam

Located in the northwestern part of Borneo, Brunei Darussalam has a land area of 5,765 km^2 with 161 km long coastline fronting the South China Sea. Its total marine territorial area is about 41,188 km^2 covering the so-called Brunei Fisheries Limits with potential yield of about 21,300 metric tons (MT). Contributing more than 70% to the country's total fish production, capture fisheries had been identified as one of the most important industries for the diversification of its economy. The overall performance (in terms of production and values) in 2012 and 2013 of the country's major commercial



	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
2012	929.4	1057	1147	1296	1175	1233	1304	1205.	1122	1133	1159.	865.1
2013	971.9	1153	1288	1316	1348	1178	889.8	1279	1278	1197	1438	983.4
% Difference	4.58	9.11	12.32	1.53	14.73	-4.44	-31.7	6.08	13.93	5.68	24.04	13.67

Fig. 1. Production from marine capture fisheries of Brunei Darussalam in 2012-2013

Fig. 2. Various types of purse seine vessels used in Brunei Darussalam waters

fishing vessels, namely trawlers, longlines and purse seiners are shown in **Fig. 1**.

The total production of Brunei Darussalam from marine capture fisheries had increased from 13,626 MT in 2012 to 14,320 MT in 2013 using small-scale and commercial fishing vessels, with the number of vessels increasing from 28 to 30, respectively. However, the main contributor of about 80% to the country's total marine capture fisheries production is the small-scale fisheries.

Small pelagic fishes comprise one of the most important components of the fishery resources of Brunei Darussalam. Among the commercial vessels, the major fishing gears being used to catch small pelagic fishes include purse seine and ring net, while gill net and drift net are used by small-scale fishers. Purse seine fishing in Brunei Darussalam started in 1985 with seven (7) licensed vessels. The areas where purse seine fishing and where specific fishing gears as well as engine capacities could operate, are specified by zones. Fish purse seine and tuna purse seine are the two types of purse seines operating in Brunei Darussalam waters. Fish purse seine was introduced in 1985 with only one licensed vessel, but no proper data recording of catch was made in the past. Fish purse seine was improved in early 1990s with the use of luring lights in fishing operations. Tuna purse seine started only in 2013 with two licensed vessels. The Department of Fisheries of Brunei Darussalam started providing incentives to fishers in the early 2000s to encourage them to record the necessary information during fishing operations. As a result, relevant fisheries data had already been compiled starting in 2001.

Commercial purse seiners in Brunei Darussalam (**Fig. 2**) operate on daily basis due to the size limitation of fish holds onboard and the high demand for good quality of fish landed. Commercial purse seine fisheries make use of fish aggregating devices (FADs) and lights as fishing aids to catch small pelagic fishes. Reports indicated that most of the country's purse seine vessels are made of wood and constructed in foreign countries, *i.e.* Malaysia, Viet Nam and Taiwan.

Cambodia

Covering an area of 181,035 km^2 including land and water, Cambodia has a coastline of 435 km which stretches between its borders with Viet Nam in the south to Thailand in the west. Four provinces of the country are located along this coastline, namely: Koh Kong covering a coastal length of 237 km, Sihanoukville with 105 km coastline, Kampot with 67 km, and Kep with 26 km. As reported, 525 species of marine fishes, 20 species of marine crabs, 42 species of marine gastropods, 24 species of marine bivalves, and 11 species of marine mammals, are found in the country's oceanic waters. The Kingdom of Cambodia has its Exclusive Economic Zone (EEZ) that extends from the shoreline to 200 nautical miles and covers an area of 55,600 km^2.

Cambodia is endowed with inland and marine fishery resources that play very important role in the economy and food security of the country. The fisheries sector provides employment and economic benefits to a large number of people who are involved in fishing and its ancillary activities. Due to the physical characteristics of the country's EEZ,

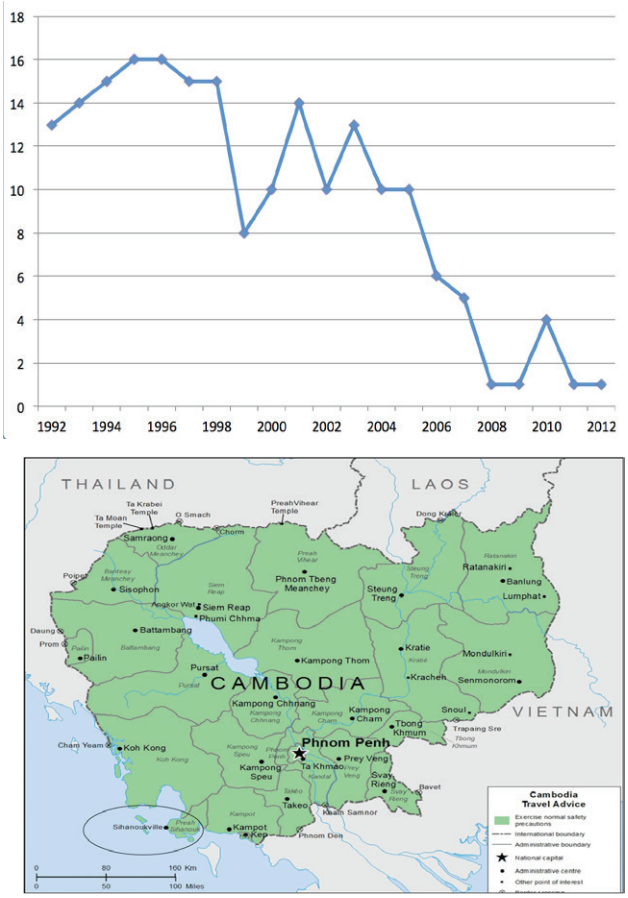


Fig. 3. Total number of purse seine vessels (*top*) recorded in Sihanoukville, Cambodia (*above*)

marine fisheries in Cambodia are mostly pelagic and their productivity contributes about 20% to the national fish production annually. Its marine fisheries could be classified by types of fishing gears, namely: small-scale, middle-scale and large-scale fishing gears operating mostly through foreign fishing ventures. Local vessels use variety of fishing gears including trawl nets, drag nets, purse seines, anchovy purse seines, gill nets, hooks and lines, and traps. In recent years, majority of coastal fishing vessels have been motorized, as a result, non-motorized vessels had reduced drastically from 3,312 in 1996 to 227 in 1999. Production of the country's marine capture fisheries had increased from 75,000 MT in 2009 to 110,000 MT in 2013 (SEAFDEC, 2015). However, it should be noted that most of the catch derived from Cambodian waters might not have been recorded in the country's national statistics considering that being harvested by foreign fishing vessels, the catch could have been shipped directly to the vessels' flag states, *e.g.* Thailand, Viet Nam.

Modern fishing technologies introduced to Cambodia sometime around the 1950s, comprise the bottom trawl and purse seine. Currently, purse seine, gill nets and long lines are the major fishing gears used by the country's coastal fishers since the early stage of fishing technology development. Generally, small-scale fishers operate from 1.0 to 45.0 km from the shoreline with water depths of 4.0 to 30.0 meters. The national fisheries statistics indicated that only one purse seine was registered in 2012 in Sihanoukville (**Fig. 3**). The number of purse seine vessels had decreased as a result of over-exploitation of targeted species due to increased use of pair trawls and light luring purse seines in the country's offshore waters. These gear types are commonly used at night, while most purse seine vessels use other fishing gear such as trawl or gill nets.

Fig. 4. Purse seine fisheries operating in Silhanoukville waters: regular fishing vessels (*top*) and long-tail vessels (*above*)

In the waters of Sihanoukville, purse seine vessels are mostly operated in the same inshore areas (**Fig. 4**). However, purse seine vessels from Kampot Province rarely operate in Kampot waters but mostly operate in Sihanoukville waters instead. Usually, one fishing operation trip of a purse seine takes about 2 to 5 days. Most purse seines operate about 5-6 trips per month.

Indonesia

Indonesia is one of the tropical countries with vast marine waters, accessing to a maritime area of 5.8 million km^2 and 3.1 million km^2 of EEZ. For fisheries management purposes, the Indonesian waters are divided into 11 fisheries management zones (**Fig. 5**) by virtue of Ministerial Decree No. PER.1/MEN/2009. Its marine fisheries mostly relate to the characteristics of the continental shelf. In general, there are three types of shelves in Indonesia's marine waters: the shallow waters (<200 m) of Sunda shelf (Java, Natuna Seas and Malacca Strait) in the western part, Sahul shelf (Arafura and Aru Seas) in the eastern part, and the deep-sea waters in between.

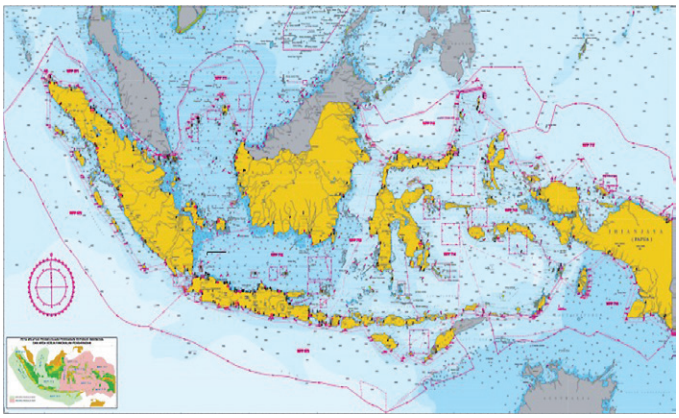


Fig. 5. Fisheries management zones of Indonesia

The characteristics of the shelves influence the fishing activities in Indonesia's waters and indicated by the use of different fishing gears. The country's capture fisheries statistics showed that its marine fish production in 2013 was about 5.7 million MT. Small pelagic species dominate the national annual landings with an estimated volume of 31% of the total fish production. In 2007, the total number of fishers at 2.2 million was mostly involved in small-scale fisheries. Purse seine fishery in the north coast of Java Sea is one of the most productive fisheries in Indonesia. Development of the country's purse seine fishery began in Central Java using large and medium purse seines (GT> 30 tons). From 1973 to

1983, pelagic fishing was only done in Java Sea but later this expanded from the west into the South China Sea (around Natuna Island, Tarempa, Pejantan) and in the shallow waters of western Makassar Strait (approximately in Lumu-Lumu, Samber Gelap, Lari-larian). However, expansion of the Javanese purse seine fishing grounds reached its maximum in 1995. Thus, most of the existing purse seiners previously operating in Java Sea changed their target species from small pelagic fishes to small tuna and tuna-like species, and among the various kinds of fishing gears, gill net and longline are used in fishing operations. The number of purse seine vessels operating in Java Sea of about 28,000 units, contributes about 2.6% to the total number of fishing vessels used in Indonesian waters.

Malaysia

The fishing areas of Malaysia are divided into several sub-regions, namely: the West Coast and East Coast of Peninsular Malaysia, and Sabah and Sarawak. Located on the West Coast of Peninsular Malaysia, Malacca Strait embraces the north Andaman Sea and the Indian Ocean, and bordered by the State of Perlis which is the country's main landing site for neritic tunas followed by Kedah, Penang, Perak and Selangor. The East Coast of Peninsular Malaysia faces the South China Sea and the country's EEZ in the SCS consists of continental shelf of 200 m deep, continental slopes and the deeper waters down to more than 2,000 m. This EEZ which extends 200 nm offshore is covered mostly by the continental shelf except the areas on the north of Sarawak and Sabah. For Sabah, the continental shelf areas only extend as narrow as 12 nm from the shoreline. The total EEZ area or continental shelf in the East Coast of Peninsular Malaysia is about 115,217 km^2 (**Fig. 6**). Vitally important to Malaysia, its fisheries sector contributes to the national economy in terms of income, foreign exchange and employment, as well as ensuring protein and food supply for the future generation. In 2012, the country's total marine landings increased by 7% from 1,373,105 MT in 2011 to 1,472,240 MT. Meanwhile, inshore fisheries contributed 64% and 60% in terms of quantity and value, respectively to the national food fish sector while deep-sea fisheries contributed only 19% and 16%, respectively. Pelagic fishes contributed about 38% (562,732 MT) of the country's total marine production and the rest

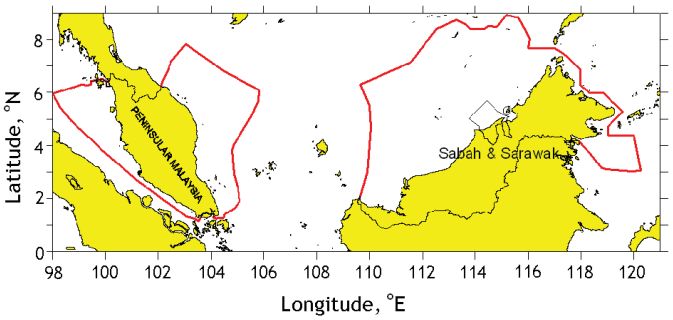


Fig. 6. EEZ boundaries of Malaysia

was contributed by demersal fishes, mollusks, crustaceans, and others. Landings from purse seine vessels recorded an increase of 7% in the East Coast of Peninsular Malaysia from 110,565 MT in 2011 to 118,698 MT in 2012.

Four major fishing activities in Malaysia are defined according to the fishing techniques adopted, namely: fish trawl, shrimp trawl, fish purse-seine, and anchovy purse-seine fishery. Fish purse seine is the main fishing gear used in catching pelagic fishes in Peninsular Malaysia, Sabah and Sarawak. Purse seines are the second most efficient fishing gears that contribute to the country's total fish landings after trawlers. **Table 1** shows the number of purse seine vessels which had significantly reduced from 1,280 units in 2012 to 1,238 units in 2013. The country's purse seine vessels have been categorized based on their gross tonnage (GRT), *i.e.* 25.0-39.9 GRT (beyond 8 nm offshore), 40.0-70.0 GRT (15 nm offshore), and above 70.0 GRT (above 30 nm offshore). Two types of methods are adopted during purse seine operations, *i.e.* using fish agregating devices (FADs) and without FADs or free searching (free school). FADs are normally set in areas where the water depths exceed 40 m. Luring materials for FADs are made from coconut leaves anchored using several concrete sacks.

Table 1. Number of purse seine vessels in Malaysia (2012-2013)

Area	2012	2013
East Coast of Peninsular Malaysia	495	487
West Coast of Peninsular Malaysia	441	443
Sabah	301	274
Sarawak	43	34
Total	**1,280**	**1,238**

Myanmar

The fisheries sector in Myanmar is one of the major components that significantly contribute to the country's economy. Fish provides a major source of animal protein in the diet of Myanmar people who largely consume rice and fish in their daily life with annual fish consumption of about 51.0 kg per capita in 2012. As promulgated, the Myanmar Special Economic Zone for Marine Fishing has been established from the shoreline to 200 nautical miles offshore. The territorial sea of Myanmar extends 12 nautical miles from the shoreline. The total area of its fishing ground including its EEZ is about 486,000 km^2. Myanmar's coastline is divided into three coastal regions, namely: Rakhine Coastal Region, the Ayeyarwady and Gulf of Mottama (the Delta Zone), and Tanintharyi Coastal Region (**Fig. 7**). The country's marine capture fisheries sector is categorized into two major types: coastal or inshore fisheries, and offshore or deep-sea fisheries.

Purse seine is a major fishing gear used to exploit the pelagic fish resources of the waters of Myanmar. The two main types

Fig. 7. Map of Myanmar showing its coastal regions

of purse seines employed in Myanmar waters are fish purse seine to catch pelagic species like hilsa, and anchovy purse seine (two-vessel seine) to catch anchovies and operate in coastal waters, especially in the northern area of Rakhine State. Most fish purse seine vessels are about 50 to 100 GRT, and are operated in a traditional manner without the use of FADs. Most purse seiners have a skipper with expertise in searching fish schools using sonar. Hilsa is the major species caught by purse seine from October to May. Anchovy purse seine vessels are normally operated by two vessels in shallow inshore areas and mainly target the anchovies *Stolephorus* spp. **Table 2** shows the landings of anchovy purse seine fisheries in Myanmar.

Light luring is also used in purse seines to attract free-schooling fish at night, and mainly harvesting the small mackerels and sardines, particularly along the northern coast of Rakhine Coastal Region. **Table 3** shows the number of purse seine vessels operating in the offshore waters of Myanmar.

Philippines

In 2011, the Philippines ranked 11th among the top fish producing countries in the world with total production of 4.97 million MT comprising fishes, crustaceans, mollusks, and aquatic plants, contributing about 3.0% to the total world production of 178.2 million MT. In 2012, the Philippines' total fisheries production of 4.87 million MT was about 2.2% lower compared with the previous year's production. Three major fishing sectors contributed to the country's annual fisheries production, namely: the commercial sector with increased production of 0.9% (1.04 million MT) compared to previous year's production of 1.03 million MT, the aquaculture sector which produced 2.5% lower than the previous year's level, and the municipal sector with production that reduced by 3.9% during the same period. The country's fishing industry employs a total of 1,614,368 fishing operators and fishers nationwide of which the municipal fisheries sector accounted for more than one million (1,371,676), while the commercial and aquaculture sectors added some 16,497 and 226,195 operators and fishers, and fish farmers, respectively.

The growth of Philippine fisheries production showed a decreasing trend from 5.1 million MT in 2009 to 4.7 million MT in 2013 (SEAFDEC, 2015). In terms of value, the country's fisheries production in 2013 was valued at US$5.4 billion (about 245 billion Philippine Pesos (PHP); US$1.00=PHP45.00) had increased compared to US$4.3 billion (or PHP 194 billion) in 2009. The major fishery

Table 2. Landings of anchovy purse seine fisheries (2005-2014) of Myanmar

Year	Number of vessels	Catch (MT)				Total (MT)
		Anchovy	Sardines	*Rastrelliger* spp.	Others	
2005-2006	368	4,505	1,457	100	1,030	7,092
2006-2007	377	1,978	1,842	30	3,857	7,707
2007-2008	375	5,024	1,028	58	3,022	9,132
2008-2009	374	6,188	2,215	44	2,170	10,617
2009-2010	375	6,973	3,216	20	3,998	14,215
2010-2011	377	7,873	3,926	32	4,301	16,132
2011-2012	366	5,031	1,816	53	5,812	12,712
2012-2013	362	4,205	2,510	79	4,098	10,892
2013-2014	360	2,156	4,773	124	6,899	13,952

Table 3. Number of purse seine fishing vessels of Myanmar engaged in offshore fisheries

No	Type of Gear	Year					
		2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013
1	Fish Purse Seine	152	158	161	168	273	278
2	Anchovy Purse Seine	375	374	375	377	366	362

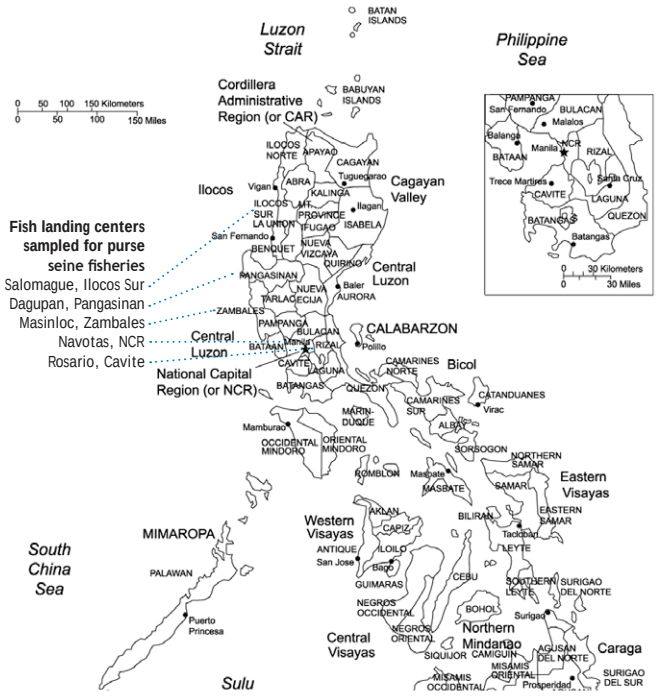


Fig. 8. Map of the Philippines showing the fish landing centers used for sampling purse seine fisheries

resources exploited in the Philippines are the small pelagic species, tunas and other large pelagic fishes, demersal fishes, and invertebrates. The country's small pelagic fisheries have been contributing significantly to its total fisheries production, and are also considered the major source of inexpensive animal protein for lower-income groups of people in the Philippines. In 2003, the Philippines established four sampling sites in landing centers of purse seines and ringnets as the target fishery in the South China Sea (**Fig. 8**). These are in Rosario (Cavite), Navotas (National Capital Region or NCR), Masinloc (Zambales), and Salomague (Ilocos Sur). Sampling in Masinloc and Salomague was however discontinued effective August 2003 as the purse seine landings have indicated deficiency of the five target species. Subsequently, Dagupan fish landing was added to cover the major landings of roundscads as well as mackerels from the Danish seine fishery in Lingayen Gulf. In 2013, there were 73,464 fishing gears operated by 68,315 small-scale fisheries, fisherfolk associations and cooperatives. **Table 4** shows the distribution of the country's fishing gears.

Table 4. Distribution of fishing gears in the Philippines

Fishing gears	Units
Gillnets	16,404
Hook and lines	9,449
Lambaklad	7
Fishpots	3,659
Payao	1,828
Squid jigger	1,005
Motorized bancas	1,044
Fish traps	488
Multiple handlines	2,842
Tuna handlines	4,122
Marine engines	4,019
Crab lift nets	2,000
Crab pots	24,297
Non-motorized bancas	1,674
Others	626

Thailand

Several years before 2007, Thailand was among the top ten countries in terms of marine capture fisheries production with annual landings of more than 2.5 million MT, but this figure had slightly decreased since then. Apart from the changing of catch report format where catch from waters outside the country's EEZ had been excluded from the national marine capture production statistics, the decreasing fishery resources became a major issue. The EEZ of Thailand covers 420,280 km^2: 304,000 km^2 in the Gulf of Thailand (GoT) and 116,280 km^2 in the Andaman Sea Coast of Thailand (ASCoT). There are 23 coastal provinces surrounding these two main fishing areas, 17 of which are in the GoT with total coastline of approximately 2,700 km, and 6 provinces in ASCoT covering 865 km of coastline. The fishing grounds are divided into seven (7) zones, namely: zone 1 to zone 5 in the GoT, and zone 6 to zone 7 in the ASCoT (**Fig. 9**).

Catches from the Gulf of Thailand and Andaman Sea together make up the country's total production from marine capture fisheries. Currently however, such production showed decreasing trend from both fishing grounds. In 2011, the total pelagic catch was 564,956 MT of which GoT contributed 70% and ASCoT shared the other 30% (**Fig. 10**, **Table 5**).

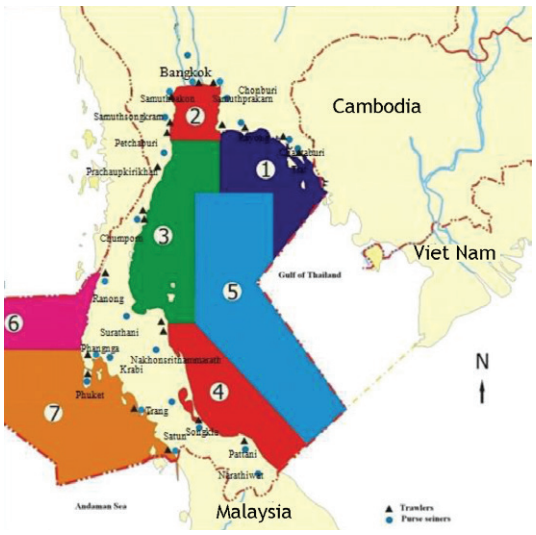


Fig. 9. Fishing zones in Thailand waters

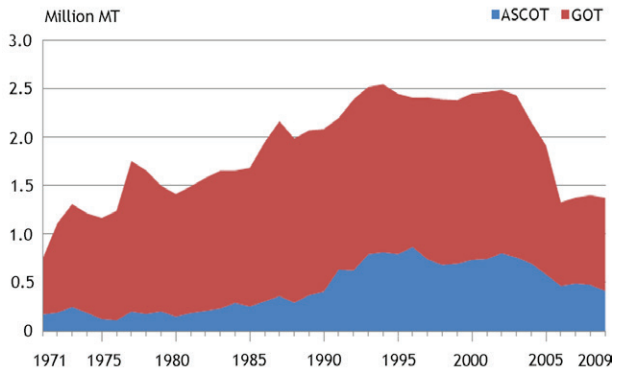


Fig. 10. Total pelagic catch from GoT and ASCoT

Table 5. Catch of marine capture fisheries (2011)

Category	Catches (MT)	Percentage (%)
Pelagic fish	564,956	41.2
Demersal fish	144,881	10.6
Cephalopod	138,344	10.0
Crustacean	76,714	5.6
Other food fish	108,297	7.9
Other miscellaneous fishes	51,006	3.7
Trash fish	287,430	21.0
TOTAL	**1,371,628**	**100.0**

In 2011, the Marine Fisheries Research and Development Bureau (MFRDB) of the Department of Fisheries of Thailand conducted a survey of the country's fishing grounds, and the corresponding database has been revised regularly in order to publish up-to-date data. Based on the current database, there are 56,979 fishing vessels, 60% of which are small-scale fishing vessels. Purse seines are the major fishing gear used for catching pelagic fishes in coastal areas. The total number of purse seine vessels as of 2011 was 1,641 comprising small vessels (10-25 m) and large vessels (>25 m). In 2011, a total of 1,224 vessels were operating in GoT and 417 vessels in ASCoT (**Table 6**).

Thailand's purse seine fisheries could be categorized into six types (**Table 7**), namely: Thai purse seines (TPS), coconut leaves luring purse seines (LPS), light luring purse seines (LLPS), day-anchovy purse seines, night-anchovy purse seines, sardines purse seines, silverside purse seines, and acetes purse seines. TPS, LPS and LLPS are the major types of purse seines and commonly found in the GoT and ASCoT. TPS, LPS and LLPS mostly employ 1.0 inch mesh size nets to harvest common pelagic fishes. However, some TPS use 4.0-inch mesh size nets to target neritic tunas.

Viet Nam

Viet Nam has a coastline of 3,260 km and the EEZ that covers more than one million km^2. Based on its natural characteristics, the waters of Viet Nam could be divided into five regions, namely: Gulf of Tonkin, Central waters, Southeast waters, Southwest waters, and Central of Bien Dong (**Fig. 11**). Its fisheries sector plays an important role in the country's social and economic development contributing 3% to the GDP of Viet Nam, and fish provides about 40% of the animal protein consumption of its people.

Table 6. Number of purse seine vessels by size operating in the waters of Thailand (2011)

Type of Gear	Number of vessels by length				
	Total	10-14 m	14-18 m	18-25 m	>25 m
ASCoT	417	47	78	271	21
GoT	1,224	231	171	759	63
Total	**1,641**	**278**	**249**	**1,030**	**84**

Table 7. Total number of purse seine by types in Thailand

Type of purse seines	Total number	Number of vessel by Areas	
		GoT	ASCoT
Thai purse seine, TPS	584	373	211
Luring purse seines	534	422	112
Coconut leaves luring purse seine, LPS	344	315	29
Light luring purse seine, LLPS	190	107	83
-lamp	6	5	1
-electric bulb	184	102	82
Anchovy purse seines, APS	484	396	88
Sardines purse seine	19	18	1
Silverside purse seine	14	14	-
Acetes purse seine	6	1	5
Total	**1,641**	**1,224**	**417**

Fig. 11. Map of Viet Nam showing Gulf of Tonkin and other coastal regions

Starting with traditional fishing with small artisanal vessels operating mainly in near-shore areas, marine capture fisheries of Viet Nam has developed rapidly, while fishing efficiency and the quality of marine catches have also improved considerably. Policies established by the Government for offshore fishing and resources stability in coastal areas encouraged fishing operators to invest in building new vessels with high engine capacity to explore fishing operations in open seas. Thus, the number of fishing vessels had increased from 79,996 to 128,363 in 2002 to 2011, respectively but started to decrease in 2011 (**Table 8**).

The annual total catch from marine capture fisheries in Viet Nam had increased during the past decade. From a total catch of about 1.99 million MT in 2005, this increased to 2.59 million MT in 2007, and further increased to 3.12 million MT in 2009 (**Table 9**). During 2007-2009, the catch from purse seine fisheries was about 16-22% of the country's total annual catches.

Purse seine is one of the most important types of fishing gear for marine capture fisheries in Viet Nam. It is also one of the potential fishing gears for offshore fishing operations. Marine production from purse seine fishery is about 20.6% of the country's total marine catch. The main species landed by local and commercial purse seine operations are small pelagic fishes comprising sardines, mackerels, roundscads, skipjack, and anchovy, among others. The country's purse seine fishery makes use of two types of fishing methods, either using luring techniques or searching method. Based on the structure and size of the nets, the country's purse seine could be categorized into searching purse seine for catching small pelagic fishes or tuna.

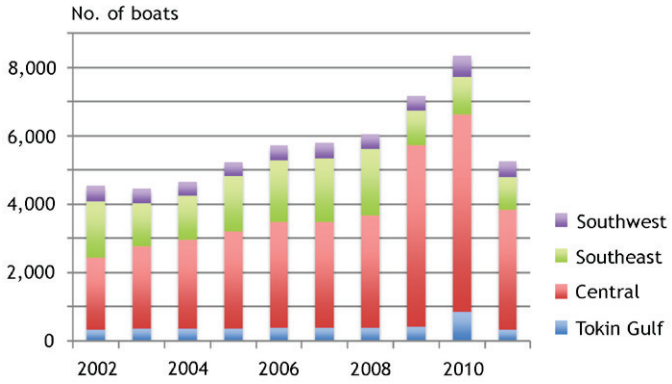


Fig. 12. Number of purse seine vessels in Viet Nam (by fishing areas)

Fig. 12 shows the number of purse seine fishing vessels in Viet Nam from 2002 to 2011, which had its lowest in 2003 (4,471 units) and highest in 2010 (8,348 units). Contributing about 4.1-6.9% of the country's total fishing vessels, purse seine fisheries are well developed, especially in the Central and the Southeast waters. Purse seine fisheries in the Gulf of Tonkin and the Southwest waters have been quite stable throughout the last decade. In the Central waters, the number of purse seine vessels were observed to increase from 2002 to 2010 while those in the Southeast waters, the number has been fluctuating with the highest number recorded in 2008.

Table 8. Total number of fishing vessels in Viet Nam

Year	Total number of fishing vessels	Year	Total number of fishing vessels
2002	79,996	2008	99,589
2003	75,053	2009	120,326
2004	71,905	2010	128,021
2005	80,968	2011	128,363
2006	85,705	2012	123,125
2007	84,224	2013	117,016

Table 9. Annual catches of the marine capture fisheries in Viet Nam by fishing areas

Year	Annual catches (MT)				Total
	Gulf of Tonkin	Central waters	Southeast waters	Southwest waters	
2007	386,838	724,097	937,903	544,829	2,593,667
2008	416,507	1,100,997	918,066	436,860	2,872,430
2009	553,377	1,103,883	910,130	550,164	3,117,554

Conclusion and Way Forward

Small pelagic fishes such as the Indian mackerels, scads and sardinellas are commercially-important commodities in the Southeast Asian region. In 2010 for example, more than 800,000 MT of mackerels (*Rastrelliger* spp.), 700,000 MT of scads (*Decapterus* spp.) and 800,000 MT of sardinellas (*Sardinella* spp.) were captured in the waters of Southeast Asia. Capture fisheries targeting these fishes are of fundamental importance to the Southeast Asian region in terms of employment and livelihood of fishers. Purse seine is one of the major fishing gears used to catch small pelagic fishes. However, management of purse seine fisheries has not yet been developed because information on the stocks is still inadequate.

Expanding the catches of small and large pelagic species by purse seine fisheries could still be carried out as long as national governments enforce control and management of their respective fishing fleets. It is therefore necessary to establish a management plan, although such effort would require developing the best way to assess the size and state of the stocks for accurate total allowable catch (TAC) allocation and to find the most applicable TAC system for purse seine fisheries in the Southeast Asian region. Considering the likelihood that such stocks are shared by the bordering countries with the same ecosystems, *i.e.* of the Andaman Sea and the South China Sea, effective management of the shared stocks would require appropriate measures to be taken for the whole coverage areas which are beyond the national waters.

In an effort to attain the aforementioned goal, SEAFDEC/MFRDMD embarked on a five-year project in 2013 on Comparative Studies for Management of Purse Seine Fisheries in the Southeast Asian Region. With the cooperative involvement of the eight aforementioned countries, the project compiles and compares the region's annual and/or monthly CPUE where data are available for the last three decades.

The project would analyze and benchmark such information with the purse seine fisheries management systems/measures including TAC systems and other management measures that have been successfully adopted in the world's fisheries. Moreover, the project would also carry out a genetic study of commercially-important pelagic species, and develop management strategies for sustainable purse seine fisheries in the Southeast Asian region.

Considering that catch-effort statistics are available in Malaysia and Thailand, and CPUE is an indirect measurement of abundance of a target species in fisheries, MFRDMD has attempted during the last three decades, to examine the trend of resource level using the CPUE. At the same time, MFRDMD is also reviewing the purse seine fishery management systems including TAC systems and other management measures in the world to examine which management system/measure is applicable for the management of small pelagic fisheries in the Southeast Asian region.

As for the genetic study, this is aimed at verifying the extent of connectivity of commercially-important pelagic species targeted by purse seine fisheries, and providing the scientific background for concerted management actions of the SEAFDEC Member Countries for shared stocks of small pelagic species. The results would also be used for the development of appropriate management of purse seine fisheries in the Southeast Asian region. It is expected that by the end of the MFRDMD Project, a review of the available information including stock levels would be at hand to be used by the Member Countries in evaluating the management strategies for sustainable purse seine fisheries for the Southeast Asian region.

It should be noted that this MFRDMD Project corresponds to ASEAN-SEAFDEC Resolution #10 which encourages the ASEAN and SEAFDEC to "*strengthen knowledge/science-based development and management of fisheries through enhancing the national capacity in the collection and sharing of fisheries data and information*," and Plan of Action #22 on the need to "*establish and strengthen regional and sub-regional coordination on fisheries management and efforts to combat IUU fishing including the development of regional/sub-regional Monitoring, Control and Surveillance (MCS) networks*."

References

http://www.fao.org/docrep/010/ag122e/AG122E07.htm

FAO. 2001-2016. Fishing Gear types. Purse seines. Technology Fact Sheets. ***In:*** *FAO Fisheries and Aquaculture Department* [online]. Rome. Updated 13 September 2001. [Cited 18 January 2016]. *http://www.fao.org/fishery/geartype/249/en*

SEAFDEC. 2015. Fishery Statistical Bulletin of Southeast Asia 2013. Southeast Asian Fisheries Development Center. Bangkok, Thailand; 143 p

SEAFDEC/MFRDMD. 2015. Current Status of Purse Seine Fisheries in the Southeast Asian Region. SEAFDEC Marine Fishery Resources Development and Management Department, Kuala Terengganu, Malaysia. 76 p

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