The Surimi Industry in Southeast Asia: Trend and Demand for Raw Materials

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A significant portion of catch from trawl fishing in the Southeast Asian waters (40-70%) is considered as low-value. While before this portion was either discarded at sea or preserved with ice for the production of feeds for livestock and fish, the development of the surimi industry in the region has provided the market for what was considered before as low-value fishes. Considering that many fish species could now be utilized as raw materials for surimi production, this paves the way for the improvement of the socio-economic conditions of the fishers through increased income and reduced wastage from fishing.

Fish paste products have long been part of the Asian traditional cuisine. The recently-developed surimi has been considered one of the most popular fish paste products and a very dynamic commodity in the Asian seafood industry in view of the latest innovations in its production and utilization. Surimi literally means "fish puree", which was developed to simulate the texture and taste of the more expensive seafood products. From surimi, analogs of crab legs, lobsters, abalone, shrimps, scallops, etc. can now be produced. Surimi is an intermediate product made from minced fish meat that has been washed, refined, and mixed with cryo-protectants to attain a suitable fish texture when cooked. Although fish paste commodities have been manually produced in the Asian region for centuries, the factory production of frozen surimi started only in the early 60s in Japan, providing the impetus for expanding the surimi industry in the Southeast Asian region and the market in exporting countries. Before, surimi production in Japan was intended to process its increasing fish catch and revitalize its fishing industry, these days surimi has been considered a means of making the by-catch from fisheries useful.

Surimi Production in Southeast Asia

Recently, many fish products have been improved or developed in the Southeast Asian countries not only for domestic consumption but also for export. These include comminuted products made from minced fish meat or surmimi, such as fishball, fishcake, fish/prawn sausages and burgers, chikuwa, imitation crab stick, cuttlefish products, etc. (Ng *et al*., 1996). The production of surimi in Southeast Asia primarily makes use of demersal fish species considered before as by-catch such as the threadfin bream (*Nemipterus* spp.), big-eye snapper (*Priacanthus* spp.) and lizardfish (*Saurida* spp.). These demersal species are the most abundant low-value fishes distributed from the coastal areas to the continental shelves and slopes in the Southeast Asian waters and exhibit the appropriate characteristics for processing export-quality surimi. In addition, other demersal fishes are also being used for surimi production in the region, such as croaker (*Johnius* spp., *Pennahia* spp.) and goatfish

or red mullet (*Upeneus* spp., *Parapeneus* spp.). Malaysia also makes use of the barracuda (*Sphyraena* spp.) for the country's surimi production (Siriporn *et al*., 2007). By utilizing as surimi raw materials the by-catch and low-value species that were discarded before, the fishers can now earn additional income from their fishing operations.

Reports in 2005 have indicated that the total surimi production in the Southeast Asian region was estimated at 347,000 mt (**Fig. 1**). Thailand is the biggest producer of surimi in the region followed by Malaysia and Vietnam, with annual production of 150,000 mt (43%), 100,000 mt (29%) and 84,000 mt (24%), respectively. Moreover, Indonesia and Myanmar also produce surimi contributing about 4% of the total surimi production.

Although other countries like the Philippines, Brunei

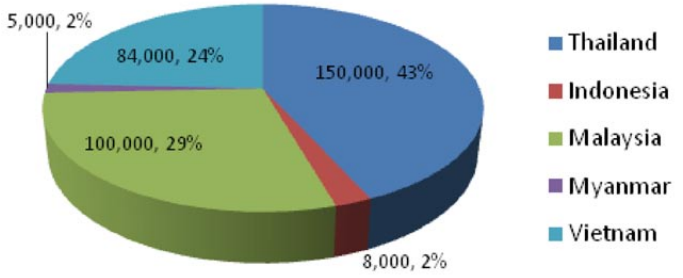

Fig. 1. Surimi production by the Southeast Asian countries (2005)

Darussalam, and Cambodia are still developing their surimi industry, these countries have also been producing comminuted products such as fish ball, fish burger, fishcake, etc. using low-value fishes. Small pelagic fishes such as scads (*Decapterus* spp.) and mackerel (*Rastrelliger* spp.) as well as other under-utilized freshwater fish species such as the soldier barb (*Cyclocheilichthys enplos*), feather-back fish (*Notopterus* spp.) and snakehead (*Channa* spp.) are now being used for the production of surimi-based products in the region (Goh and Yeap, 2007).

The maximum utilization of fish by-catch and low-value fishes as raw materials for the production of surimi and surimi-based products in the Southeast Asian region has been promoted by the SEAFDEC Marine Fisheries Research Department (MFRD) based in Singapore (Goh *et al*., 2008). Through continuous R&D efforts and with funding support mainly from the Japanese Trust Fund (JTF), MFRD has been successful in advancing the promotion of surimi and surimi-based products not only for domestic consumption but also as export commodities from the region. Moreover, through improved product development and advances in technological approaches, MFRD has continued to promote greater use of fisheries by-catch and low value species through training and extension activities and providing technical assistance to the fish processing industry in the region for the commercial application of such technologies. As of 2005, only five countries in the region have developed their respective surimi industries. Tan (1998) cited that in many countries in the region however, such as the Philippines, by-catch from fisheries is fully utilized as food in the form of salted, fermented or dried products.

Thailand

Surimi production in Thailand which started in 1978, had increased from 65,000 mt in 1994 to 150,000 mt in 2005. More than 20 surimi processing plants in Thailand make use of demersal fish species such as the threadfin bream (*Nemipterus* spp.), big-eye snapper (*Priacanthus* spp.), lizardfish (*Saurida* spp.), croaker, goatfish (*Upeneus spp*.), red snapper (*Lutjanus* spp.), etc. as raw materials for the production of surimi. Other small pelagic species such as sardines (*Sardinella* spp.) and the rainbow runner (*Elagatis bipinnulata*) are also being used to produce surimi.

In the late 70s, the fish species used as raw materials in the country's surimi industry especially the threadfin bream and big-eye snapper, were still abundant in the Thai waters (Gulf of Thailand and Andaman Sea). However, due to the rapid growth of the surimi industry in Thailand as well as the depletion of its demersal fisheries resources, Thailand had to expand its source of surimi raw materials to neighboring countries such as Myanmar, Indonesia and Malaysia. The quantity of fish raw materials supplied to the surimi industry in Thailand was 530,000 mt/year in 2005, comprising about 189,000 mt of threadfin bream, 190,000 mt of lizardfish and croaker, 119,000 mt of big-eye snapper and goatfish, and 32,000 mt from other species (Siriporn *et al*., 2007). In 2005, about 70% of the total frozen surimi production of Thailand were exported to Japan, Singapore, Taiwan, Korea, Malaysia, Hongkong, Europe, China, Canada, and the USA, while about 30% was used in the country's surimi-based fish paste commodities production. Singapore imports about 8,600 mt of surimi per year from Thailand for its fish ball and fish cake industry (Tan, 1998).

Malaysia

Malaysia produces three types of surimi products, namely: surimi, otoshimi and surimi-based products. The country registered six surimi processing plants, producing about 100,000 mt in 2005-2006. Almost 670,000 mt of the country's marine fish production were supplied to the surimi processing plants in 2005 and used as raw materials for surimi production. The main fish species used are: barracuda (32%), lizardfish (23%), threadfin bream (19%), big eye (15%), croaker and goatfish (10%), and other species (1%). The raw materials for the country's surimi production come from its EEZ waters such as the Malacca Strait and east coast of Peninsular Malaysia as well as in the waters of Sarawak and Sabah. In Malaysia, surimi is being used to

manufacture local surimi-based products and also exported to many countries. The main importers are the USA and Chile sharing about 65%, and about 15% and 10% are exported to Japan and Singapore, respectively.

Vietnam

Information from Vietnam's National Fisheries Quality Assurance and Veterinary Directorate (NAFIQAVED) showed that the country's frozen sirimi production from 17 processing plants was about 84,000 mt in 2005, an increase of more than 500% from its production of 16,500 mt in 2003. The fish species used as raw materials for surimi production in Vietnam are the King snapper (*Pritipomoides filamentosus*) about 24%, lizardfish (23%), big eye snapper (19%), white croaker (19%), and other species (15%). These raw materials come from the country's EEZ waters especially from the Gulf of Ton Kin and from the southern part of Vietnam such as Cat Ba Island, Hai Phong and Bach Long Island, Da Nang, Kian Giang, Kan Hoa, Ca Mau, Vung Tau, Kien Giang, Tien Giang, and Binh Thuan.

Five of the processing plants share about 50% of the county's total frozen surimi production while the other 12 share the remaining 50%. Almost 90% of the total frozen surimi production of Vietnam is exported to Korea and Japan (about 60% and 28%, respectively) while the other 10% is exported to Singapore, Thailand, Malaysia, China, Taiwan, USA, EU, Australia, New Zealand, Russia, and Mexico.

Indonesia

Indonesia is the largest country in the Southeast Asian region also having the largest shelf area (up to 200 m) which is about 2,700,000 km^2 and an EEZ area of 2.7 million km^2. Although many fishery resources of the country can be used as raw materials for surimi processing, there are only eight processing plants located mainly in mainland Java, producing an estimated of less than 8,000 mt of surimi products. The raw materials used for the country's surimi production are the threadfin bream (68%), goat fish (13%), croaker (10%), big eye snapper (8%), and other species (1%), which come from Java Sea, and the seas around Riau and Jambi Province in west Kalimantan. The quantity of frozen surimi produced by the six processing plants in Indonesia was about 8,000 mt in 2005, which was exported to the Asian countries only such as Korea, Japan, Singapore, Taiwan, and Hong Kong.

Myanmar

The people of Myanmar have a long tradition of producing fish paste, fish sauce, dried fish, salted fish and pickled fish, fish crackers, etc. Shrimp heads, very small fish and even mollusk shells are used for animal feeds. However, better utilization of the country's fisheries by-catch is now being promoted to produce surimi products. In Myanmar, there is one surimi plant located in Yangon which was established in 1994-95 and produces mainly surimi from low-value fish species. In 2007, there were five processing plants

producing surimi and one was still under construction. The production capacity of the county's surimi processing plants was 5,000 mt in 2005. The fish species used as raw materials by the surimi processing plants in Myanmar, include the threadfin bream (58%), big head pennah croaker (16%), goatfish (14%), lizard fish (6%), big-eye snapper (4%), and small barracuda (2%). All raw materials come from the Myanmar waters namely in Rakhine, Ayeyawaddy, Mon, and Tanintharyi fishing grounds. In 2004-2005, Myanmar exported 4,230 mt of surimi to many countries, mainly to Japan which imported about 80% of the country's total surimi production. The other importing countries are China (18%) with Australia, Singapore, Taiwan, and Malaysia importing the remaining 2% of the surimi production.

Demersal Fish Resource as Main Supplier of Surimi Raw Materials

A further analysis of the status of the surimi industry in the Southeast Asian countries conducted by the SEAFDEC Training Department (TD) based in Samut Prakan, Thailand has established a linkage between the demand for raw materials (by the surimi industry) and the region's demersal resources as the supplier of the raw materials (Siriporn *et al*., 2007a). However, the development of the surimi industry in the Southeast Asian region is still constrained by the unstable supply of raw materials even considering that the region produces considerable quantities of marine, coastal, demersal and pelagic fishes (**Table 1**), the significant portions of which could be used as raw materials for surimi production.

It has therefore become necessary to specifically understand the status of the demersal fish resources as raw materials for surimi production and to search for new fishery resources in the region to supply the demand of the region's surimi industry. In order to address such concern, TD conducted an activity on information collection of economically important species as surimi raw materials under the Japanese Trust Fund Project on the Development of Demersal Fishery Resources Living in Un-trawlable Fishing Grounds in the Southeast Asian Waters. The results of the information collection activity indicated that most common demersal species used as raw materials for surimi production in the region belong to five families, namely: Nemipteridae, Synodontidae, Priacanthidae, Mullidae, and Sciaenidae. Together with the demand of the surimi industry in Southeast Asia, the results also showed that production growth for these five families of demersal fishes (SEAFDEC, 1976-2005), has been increasing during the past 30 years to a level of about 625,000 mt in 2005 (**Fig. 2**).

The 2005 production trend of the five demersal families, namely Nemipteridae, Synodontidae, Priacanthidae, Mullidae, and Sciaenidae which are used as raw materials for surimi production indicated that Thailand contributed about 45% while Indonesia shared about 28%, Malaysia and the Philippines contributed about 15% and 12%, respectively while the contribution of Singapore was almost nil (Siriporn *et al*., 2007a).

These demersal fishes considered before as by-catch are now also being used for a wide range of fish products for local consumption. Tan (1998) reported that Malaysia has been successful in the production of fish "satay" using the goatfish (Family Mullidae). In addition, several processing plants in Thailand have also produced surimi-based product analogs of the cuttlefish and squid slices using a mix of the several fisheries by-catch. Although the surimi industry targets to produce high grade surimi for export, processing plants in the region have benefited from using surimi as raw material in the production of fish products for the domestic market, thus production of lower grade and lower-priced surimi for the local processing markets has increased.

Table 1. Production of miscellaneous marine fishes from capture fisheries in the Southeast Asian region

Countries	2001	2002	2003	2004	2005	2006
Brunei Darussalam	1,186	1,528	1,594	1,771	1,750	1,750
Cambodia	26,500	28,550	33,747	34,330	37,000	37,400
Indonesia	567,047	523,403	798,820	780,343	874,198	912,633
Malaysia	413,421	445,613	446,141	437,991	440,963	428,745
Myanmar	926,070	1,006,160	1,030,720	1,109,640	1,206,330	1,351,670
Philippines	14,656	16,527	14,725	14,024	12,559	14,854
Singapore	1,325	1,031	707	651	507	769
Thailand	984,490	937,848	964,203	953,340	931,426	946,369
Vietnam	1,101,761	1,168,691	1,210,025	1,315,811	1,349,000	1,377,500
Total	4,036,456	4,129,351	4,500,682	4,647,901	4,853,733	5,071,690

Source: *FAO FishStat Plus (2008)*

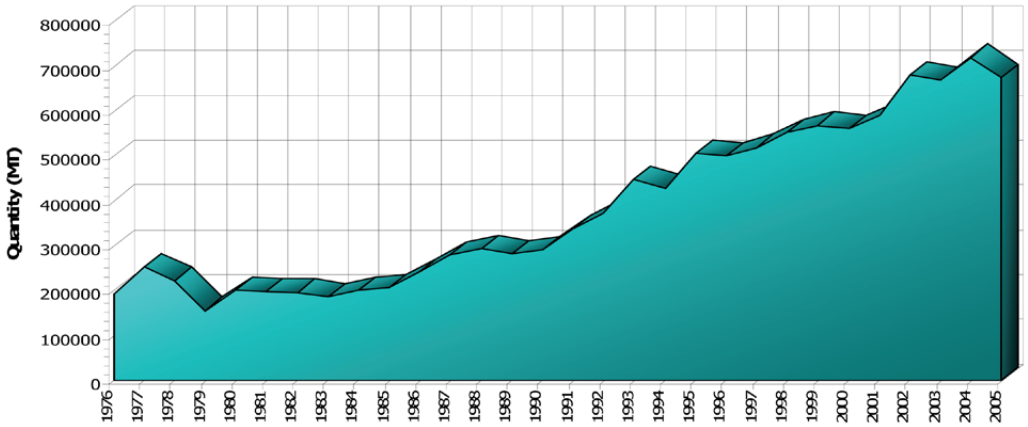

Fig. 2. Production trend of five important demersal fish species used as surimi raw materials in the Southeast Asian region *(Source: SEAFDEC (1976-2005))*

Threadfin bream (Nemipteridae)
The Philippines which posted the highest production of threadfin bream from 1976 to 1990 experienced a continued decrease starting in 1991, during which time the production of Thailand overtook that of the Philippines. Since then Thailand's production had been rapidly increasing and was the highest producer of threadfin bream among the countries in the region for 15 years (1991-2005). Threadfin bream production of Indonesia and Malaysia also slowly increased during the same period.

Lizardfish (Synodontidae)
Thailand's production of the lizardfishes had been increasing annually and after 1990 the increase was very rapid following the same pattern as that of the threadfin bream production. On the other hand, the lizardfishes production of Indonesia and Malaysia also increased but not as much as Thailand while that of the Philippines slowly decreased starting in 1978 until 2005.

Big-eye snapper (Priacanthidae)
The production growth of the big-eye snapper posted by Thailand was the same as that of the threadfin bream and lizardfishes which rapidly increased from 1990 which made Thailand the highest producer of this species too. The production trend of the big-eye snapper posted by the other countries was quite low.

Drums and croakers (Sciaenidae)
Indonesia had the highest production of drums and croakers since 1977. Although Thailand's production trend followed the same pattern as that of the other three families described above, its production of drums and croakers came second only after Indonesia. For Malaysia, production of drums and croakers was increasing every year while the production trend of the Philippines slowly decreased year by year.

Goatfish (Mullidae)
Starting from 1976, the Philippines had the highest production of goatfish compared with the the other Southeast Asian countries until 1996 when its production decreased, although its production increased again in 2002. Indonesia's production of goatfish from 1976 slowly increased and after 1992 the trend had been strongly increasing making Indonesia the highest producer of goatfish starting in 1997 until 2005. Likewise, Malaysia's production of goatfish was also increasing year by year.

Other demersal fishes
Small pelagic fishes such as sardines, round scads and mackerel have laso been considered low-value species and under-utilized especially during the fishing season. As such, these fishes usually end up as cheap raw materials for the production of fish meals. Through product development and value-adding, these pelagic fish species could now be processed into surimi-based products for the production of traditional fish snacks, e.g. the kerupok or fish cracker, fish chips, etc.

Issues and Constraints

The development of the surimi industry in the Southeast Asian region is constrained by many factors, the most significant of which is the unstable and unpredictable supply of raw materials brought about by the depleted demersal fish resources in the region. Other factors that caused the slow take off of the region's surimi industry include the low quality of materials caused by improper handling of the fishes onboard the fishing vessels, the lack of storage facilities onboard considering that the distance between the fishing grounds and the fishing ports could be quite far, and also the number of days spent by fishers in the fishing grounds which could be about one month. The current fuel crisis in 2008 also impacted on the development of the surimi industry in the region as this leads to a number

of consequences including high cost of raw materials and ingredients, increasing transport costs, increasing labor costs, etc. The strict product quality control imposed by the surimi importing countries such as the EU, USA, Japan, etc. has greatly influenced the production of export-quality surimi using high-grade fish species as raw materials, which has become expensive considering the decline of the demersal resources in the region. Considering that the price of export-quality surimi in the trading arena has remained low, the use of mixed species of fisheries by-catch to produce mixed-grade surimi could not be very sustainable as the price of mixed-grade surimi in the domestic and regional processing plants is also cheap.

Way Forward

SEAFDEC through the Training Department (TD in Thailand, the Marine Fisheries Research Department (MFRD) in Singapore, and the Marine Fishery Resources Development and Management Department (MFRDMD) in Malaysia, has conducted a number of projects and activities that could address the problems and constraints encountered by the surimi industry in the Southeast Asian region. Among the major activities include the series of surveys of the demersal fishery resources in the region conducted by SEAFDEC with the collaboration of the Member Countries. Such surveys specifically aim to collect data on the relative abundance of demersal resources in the untrawlable waters of Southeast Asia and to investigate the existing potential demersal fishery resources in the Southeast Asian waters.

Funded by the JTF Program, results of the surveys using the bottom vertical longline gear have indicated that high-value demersal fishery resources specifically the groupers and snappers are found in the untrawlable waters of Southeast Asia. The data from the surveys also suggested that the fishery resources in the untrawlable fishing grounds are potential resources that could be explored in deep sea fisheries (Nakaret, 2008).

To specifically address the concerns of the surimi industry, SEAFDEC conducted in December 2007 the Regional Workshops on Information Collection of Demersal Resources as Surimi Raw Materials in Southeast Asian Waters and on the Findings of Demersal Resources from the M.V. SEAFDEC 2, with the main objectives of evaluating the status of demersal fishery resources as surimi raw materials in the region, reviewing the trend of demersal fisheries resources as surimi raw materials in SEAFDEC Member Countries, and discussing future exploration plans on demersal fisheries resources. The fisheries resources particularly the demersal resources in the seas of Southeast Asia was also scientifically assessed during the Workshops, considering that such resources have been reported to be already depleted. The said phenomenon could also be observed from the total marine fish catch which comprises almost 60-70 trash fish and the size of fish which had been getting smaller, greatly affecting the surimi industry in the region.

Box 1. Recommended measures to mitigate the conflicts between man and processing industries in exploiting the region's demersal resources (SEAFDEC, 2007)

(1) develop appropriate fisheries management systems
(2) strict enforcement of MCS
(3) explore the possibility of increasing the price for resource utilization, e.g., increasing price of surimi but striking a balance between price and resource management
(4) fishing operations should target only species for surimi production and avoid the catch of juveniles of other commercially important species, e.g., promoting the use of JTEDs
(5) promote the continued use of trash fish or low-value fish for surimi production
(6) develop technology for using pelagic fishes in surimi production, e.g., horse mackerel
(7) reduce post-harvest losses through good preservation and handling techniques onboard fishing vessels
(8) tap potential sources of raw materials outside the region for surimi production
(9) continue promoting the use of trash fish mainly for surimi instead of promoting it for the production of fish meal for aquaculture and livestock
(10) maximize the use of trash fish for human consumption in terms of fish meat or production of traditional fish products
(11) continue developing technology for the utilization of freshwater fishes for surimi production

The state of the region's fishery resources which have been reported to be declining could even lead to a worst scenario in the future if the competition for fish between man and the fish processing industries is not averted. The December 2007 Regional Workshops therefore recommended a number of mitigation measures (**Box 1**). Nevertheless, some countries have carried out exploratory fishing operations in their respective untrawlable waters where commercial fishing is already occurring for some species. In this connection, Somboon (2008) recommended that any decision to migrate or introduce new effort to offshore fisheries should give due consideration to the biological, technological and economic factors associated with such moves. In cases where "to move offshore" can be justified biologically and economically, care must be taken to ensure that the offshore resources are harvested sustainably and thus effective management regimes and responsible fishing practices will be the key to long term viability. Given the current interest in Southeast Asia to develop offshore fisheries, policy makers, resource managers, the fishing industry, investors and other interested

stakeholders should understand the risks and uncertainty associated with such developments (Somboon, 2008).

Moreover, TD and MFRDMD have also been conducting assessment surveys of the fisheries resources in both offshore and deep sea areas in the Southeast Asian waters and in adjacent areas of the region such as the Eastern Indian Ocean, using various fishing sampling gears such as the bottom trawl, longline and traps. The surveys have been conducted mainly in the South China Sea, the Andaman Sea and Eastern Indian Ocean to assess the status of the fisheries resources in each particular area and search for new fishing grounds and new potential resources existing in the region to facilitate future sustainable utilization and promote responsible fishing practices.

As there is evidence that most near-shore coastal areas in Southeast Asia are overfished, a common policy response is for governments in the region to encourage fishing operations in deeper off-shore waters for pelagic and demersal fishes. In a related development for the region's surimi industry, MFRD continues to develop integrated fisheries post-harvest technologies that would optimize limited resources, enhance value-added products, and reduce post-harvest losses and wastage. MFRD also continues to promote the harmonization of analytical methods for the improvement of the quality of the region's fish products and upgrading of the region's fish processing industry in order to meet the requirements of the importing countries.

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