

countries, namely: Republic of Korea, Thailand, New Zealand, and the United States had increased from about 26,000 metric tons to 260,000 metric tons during the same period. The Korean surimi industry showed the greatest potential for independent growth among the Asian surimi producers with a production of 60,000 metric tons in 1989. During this period, the surimi industry in Thailand also showed considerable growth potential dependent on technical assistance from Japan. Such successes stimulated the development of the surimi industry in the Southeast Asian countries, especially in Indonesia, Malaysia, Myanmar, and Viet Nam.

As of 2005, there were eight processing plants for surimi production in Indonesia (Pangorn *et al.*, 2007) and in 2015, the number of processing plants increased to 21 with a production capacity of about 167,000 metric tons per year (Table 57).

The rapid growth of surimi industry in Southeast Asian countries as well as depletion of demersal fishery resources and emerging new fisheries policies, led to the reduction of raw materials that impacted on the supply required by the surimi producers. In order to address such concerns, SEAFDEC conducted a study on surimi industry and its raw materials in Southeast Asia during 2005-2008, and came up with recommended mitigation measures for the sustainable management of the region's demersal fishery resources (Box 4). These measures are meant to support the policy makers in promoting the proper management of demersal fishery resources particularly the raw materials for surimi production in the Southeast Asian region.

**Box 4. Recommended measures to mitigate the conflicts between man and processing industries in exploiting the region's demersal fishery resources**

1. Development of appropriate fisheries management systems
2. Strict enforcement of monitoring, control and surveillance (MCS)
3. Exploring 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 to target only species for surimi production and avoiding the catch of juveniles of other commercially important species, e.g. promoting the use of juvenile and trash excluder devices (JTEDs)
5. Promotion of the continued use of trash fish or low-value fish for surimi production
6. Development of technology for using pelagic fishes in surimi production, e.g. horse mackerel
7. Reduction of post-harvest losses through good preservation and handling techniques onboard fishing vessels
8. Tapping of potential sources of raw materials outside the region for surimi production
9. Continued promotion of the use of trash fish mainly for surimi instead of promoting it for the production of fish meal for aquaculture and livestock
10. Maximizing the use of trash fish for human consumption in terms of fish meat or product in traditional fish products
11. Continued development of technology for the utilization of freshwater fishes for surimi production

### 1.2.2 Live Reef Food Fish

Live reef fishes, the most valued commodities in fishery trade, have long been traded around Southeast Asia. Wild fishes which are captured from coral reef areas or reared in marine culture facilities entered this trade since the 1960s as luxury food items because of their superior taste and texture. A combination of gears targeting spawning aggregations and juveniles is used to catch the fish, while the use of destructive fishing methods is also carried out to harvest live food fish especially in coral reef areas. The first major report on the collection of live reef fish for food was written by Johannes and Riepen (1995) based on their research that involved extensive interviews with government officials, industry representatives, fishers, village leaders, university researchers, divers, dive tour operators, and NGOs. Personal visits to countries involved in the trade were also conducted. Barber and Pratt (1997) described the trading of marine ornamental and live reef food fishes, and emphasized that the use of cyanide is commonly practiced in catching these commodities throughout Southeast Asia and proposed to use possible environmentally-sound alternatives that are promoted by the Destructive Fishing Reform Initiative. Lau and Parry-Jones (1999) produced a detailed and comprehensive analysis of the Hong Kong live food fish market, the first quantitative research to be carried out using analyzed data from the Hong Kong Department of Census and Statistics (HK CSD).

#### 1.2.2.1 Trading of live reef food fishes in Sulu-Sulawesi Sub-region

Reef fishes are particularly sought-after delicacy, and thus, the Chinese consumers have in recent years, turned to trading this commodity with countries well-endowed with coral reefs, such as the Philippines, Malaysia (notably Sabah), and Indonesia (Sulawesi Provinces). Hong Kong, the largest consumer of live reef food fish in Asia, has a largely urbanized population of 6.3 million and is a major center for live reef food fish trade in the region. As the demand has continuously increased in recent years, Hong Kong now imports live reef fish for food from many Southeast Asian countries as well as from Seychelles in the Indian Ocean.

Johannes and Riepen (1995) reported that the live reef food fish trade started in the late 1960s in Hong Kong. The most popular fish species traded at that time was the red grouper, *Epinephelus akaari*. Overexploitation of this species in Hong Kong and Chinese inshore waters forced fishers to move farther to Pratas Reef which is about 200 miles southeast of Hong Kong as well as to Spratlys and Paracel Islands in the South China Sea and Philippine waters. Trading of this species was so remunerative that by the mid-1980s premium live reef fish was being

exported by air as well as by sea to Hong Kong. Started in the Philippines in 1975, the live reef fish trade has spread to Palau (1984), Indonesia (1985), Malaysia (1986), Papua New Guinea (1991), and in the 1990s to Maldives, Australia, Solomon Island and Marshall Islands, Kiribati (1996) and Seychelles, Fiji, Andaman and Nicobar Island in 1998, and the Maldives.

More than 21 countries could be exporting live reef fish to Hong Kong. Indonesia, Philippines, Malaysia, Thailand, Viet Nam, and Myanmar had become major Southeast Asian trade partners for Hong Kong and Australia, Marshall Islands, Pohnpei, Papua New Guinea, Palau, Yap, Solomon Islands, Kiribati, Tonga, Fiji from the Pacific Ocean. According to the 1999 research conducted by TRAFFIC East Asia and WWF Hong Kong, the total import of live reef fish into Hong Kong was estimated to be around 32,000 metric tons with wholesale value of US\$ 500 million, based on 1997 import statistics (Lau and Parry-Jones, 1999).

Although Hong Kong appears to be the major importer of live reef fish for food, major expansion in the live reef fish trade also occurs in China, Taipei, Malaysia, and Singapore. According to Lau and Parry-Jones (1999), the common live reef fish imported into Hong Kong are the high-finned grouper (*Cromileptes altivelis*), humphead wrasse (*Cheilinus undulates*), giant grouper (*Epinephelus lanceolatus*), brown marbled grouper (*E. fuscoguttatus*), Sabah hybrid grouper (*E. polyphkadion*), orange spotted grouper (*E. coioides*), leopard coral grouper (*Plectropomus leopardus*), spotted coral grouper (*P. maculatus*), and squaretail leopard grouper (*P. areolatus*).

### 1.3 Challenges and Future Direction

Marine fisheries provide significant contribution to the region's total fisheries production, accounting for 40% by quantity and 50% by value. In assuring the sustainable utilization and management of marine fishery resources, it is necessary to have adequate data and information on the status of the concerned species. Large quantities of marine capture fisheries are derived from pelagic fishery resources, such as tunas, round scads, mackerels, anchovies, sardines, among others. Nevertheless, due to the migratory and transboundary nature of most pelagic fish species that are shared among many countries, and because these fishes move across the waters of the countries in the region, regional collaboration is necessary at appropriate levels, e.g. bilateral and sub-regional levels, to ensure the sustainable utilization of these fish species.

For tunas, the management of oceanic tunas is being undertaken under the purview of Regional Fisheries Management Organizations (RFMOs), particularly the IOTC for the Indian Oceans and the WCPFC for Western

Central Pacific region. Neritic tunas which are not covered by WCPFC but are economically important for many countries in Western Pacific Ocean of the region should be properly managed. Therefore, in order to put in place the sustainable utilization of the neritic tunas, the SEAFDEC Council in 2015 endorsed the Regional Plan of Action for Conservation and Management of Neritic Tunas or RPOA-Neritic Tunas which was developed by the AMSs under the guidance of SEAFDEC. Based on the framework of the RPOA-Neritic Tunas, stock assessment has been undertaken by concerned countries for some neritic tuna species. However, data collection still needs further improvement for the long term management of the species, particularly for the management of fishing capacity and sustainable utilization of the species which should be carried out through close collaboration among the concerned countries. For other small pelagic fishery resources in the region, lack of historical data on landing of the catch and CPUE caused difficulties in understanding the status of the resources. Hence, improved data collection of the species is also required to serve as basis for the sustainable management of the fisheries.

Other important groups of marine fishery resources comprise the demersal species, of which several low-value species have been used as raw materials for the production of surimi – one of the very important fishery products of the region since the 1980s. Due to complexities in accessing the data on the status of the region's surimi industry, collaboration among the Member Countries is necessary in order to obtain more data and information from the major surimi-producing countries. Reef fishes are another important group of demersal fishery resources, which are very highly economical, especially in terms of value from trade either as live reef food fish (LRFF) or ornamental fish. Live Reef Food Fish Trade (LRFFT) involves the capture of reef fishes which are kept alive for sale and consumption mainly in Hong Kong and mainland China. Even though live fish have long been traded around Southeast Asia as a luxury food item, trading of fish captured from coral reefs has expanded rapidly in recent decades. As a consequence, LRFFT has become a major threat to the coral reef ecosystems and marine biodiversity, aside from the impacts from overfishing, capture of juvenile fishes for grow-out and spawning aggregations, use of destructive fishing practices such as cyanide and other destructive gears, IUU fishing; and undervaluation of the resources. To address the concern on the vulnerability of LRFF, the Southeast Asian region and the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF) member countries adopted in 2013 the “**Resolution on Sustainable LRFFT.**” However, due to the continued illegal trading of LRFF in large quantities, especially to major markets not within Southeast Asia, the first steps towards addressing this issue is to seek the cooperation of these concerned countries for