Thesis for the Degree of Master of Fisheries Science

Potential and Challenges for the Sea Cucumber Fisheries with Special Emphasis on Their Effective Utilization and Trade

by

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The World Fisheries Graduate School

Pukyong National University

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(효율적인 이용과 거래를 위한 해삼어업의 잠재성 및 도전과제)

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by

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Potential and Challenges for the Sea Cucumber Fisheries with Special Emphasis on Their Effective Utilization and Trade

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Abstract

Sea cucumbers belonging to the phylum Echinodermata are important marine invertebrates, generally occur in the sandy substrates, and rocky shores near the bottom of sea. This review work has been attempted to make an interlink between biological and socio-economical perspectives of sea cucumber because of the high demand in the present world. The outside body part of sea cucumber (beche-de-mer) is known to act as a defense and has been recognized for making secondary metabolites including vitamins and triterpenoid glycoside saponins that have profound ecological and pharmaceutical significance. Due to higher pharmaceutical, cosmeceutical and nutraceutical values, sea cucumber has become one of the most essential products and it has

fetched higher foreign market prices and therefore, provide a significant earnings source and employment opportunity to the coastal communities in many countries. Sea cucumbers are also used to remove arthritis pain, exert wound healing, and in the present days, are utilized in human health therapeutics and Asian folk medicine. The sea cucumber and its product have been considered to be the excellent bioresource in the invertebrate fishery, whose harvestings, transporting, handlings, processing and maintenance are easy, convenient and do not need any special technique, procedure and equipment. After processing, the shelf-life of sea cucumber can be maintained for long times. Archaeologically, beche-de-mers were harvested from the multi-species capture fishery and stored for long times for selling to the businessmen and traders directly on the site. As like other lucrative and expensive food items (viz., fish-maws, shark-fins and abalones are taken into the account as one of the valued products in the world seafood markets. Nevertheless, beche-de-mer product supply in the South-East Asian countries has been decreasing day by day because of unstrained harvesting and overexploitation. On the other hand, the marketing structure in these countries is typically ineffective and the marketing networks are multifaceted. Due to the lack of proper information, fishermen are usually not getting proper prices and exact values from the sea cucumber products, whereas other distributors and value-chain members have made complex systems, which have led to high cost of this

product. However, the sea cucumber products will still have higher possibility of trading throughout the world markets that might eventually contribute to the global economy in a very worthwhile and significant manner.

1 Introduction

1.1 Background of the Study

Sea cucumbers are economically important echinoderms, and thus making it one of the imperative sources of income and livelihood of millions of coastal communities in the world (Purcell, 2013). They are also popularized all over the world for the dried body-wall, viscera, or to create a dry product known as 'trepang' or 'beche-de-mer' and alternative nutritional items that are extended to the eastern Asian markets (Akamine, 2004). The Indo-Pacific area is involved with trading of sea cucumber for more than one thousand years, principally for the clients of China (Conand and Byrne, 1993). Near about 66 species of cucumber animals are characteristically exploited in the world, with the largest quantities (47) from Philippines (Purcell, 2010). According to Toral-Granda et al. (2008), around 70 countries are involved with fishing and trading of sea cucumber. Around 60% of sea cucumber fisheries connects with small scale harvesting, which are generally dwelling in shallow tropical waters (Berkes et al., 2001). According to Purcell (2013), the fisheries contribution in export, regarding number of fishers/km^2 of ridge, was most elevated to be 37.4 and

followed by 18.1 and 15.9 in Philippines, Papua New Guinea and Indonesia, respectively (during ban period), whereas 1.7 fishers/km^2 in the Indian Sea and African fisheries.

Increasing market value, deficiency of alternate income source for fishermen, poor administration, and intrinsic biological and ecological vulnerability of sea cucumbers have prompted over-exploitation. Investigation showed an alarmingly high rate of excessive utilization in addition to the consumption of sea cucumber, especially in the area of Indo-Pacific regions. In general, 20% of sea cucumber fisheries has been depleted, 38% over-exploited, 14% completely exploited and 27% underexploited. About 27% sea cucumbers are taking illegally, regardless of countrywide bans. Purcell (2013) stated that these unlawful fishing happen in the Western Indian and also in Central and South American Sea. According to Toral-Granda et al. (2008), the brown sea cucumber (*Isostichopus fuscus*), is the main species from the Ecuador, as of now recorded in CITES. On the basis of analyzing 377 numbers of sea cucumber animals, the IUCN (International Union for Conservation of Nature) has red-listed seven species as endangered or at in height threat of annihilation and nine animals as susceptible or in danger of extinction (www.iucnredlist.org). Universally, the fisheries of sea cucumbers have frequently needed complete administrative plans and regulation capacity to manage unstrained exploitation (Purcell, 2013) that is apparent over the Indo-Pacific area. The national sea cucumber fisheries of the

Indian Ocean have been existed in various nations for a long time (Conand, 1990) yet the official limit with regards to administration is incapable (Eriksson and Byrne, 2015). The objective of the management for sea cucumber fisheries ought to be to protect the conceptive limit of reproducing stocks with the goal that the resources are accessible to who and what is to come (Purcell, 2010). Requirement (consistence) limit changed significantly among fisheries and would in general be frail in tropical region fisheries with low-pay nations. This is discovered to exhaust and over-exploit cucumber fisheries would in general have more or less governmental actions (mean: 2.6) than the best fisheries performance (mean: 4.7) (Purcell, 2013) and this is stressed to have numerous government estimates that are effortlessly comprehended then implemented (FAO, 2010). In any case, the worldwide population of sea cucumber has not dropped in light of the fact that there are as yet accessible supplies, aquaculture production, constrained open preservation mindfulness and lacking administrative condition (Eriksson and Clark, 2015). The objective of the management for sea cucumber fisheries ought to protect the conceptive limit of broodstocks with the goal that the resources are accessible to who and what is to come (Purcell, 2010). Condition (consistence) limit changed significantly among fisheries and would in general be fragile in tropical sections fisheries with low-pay nations. This is discovered to exhaust and over-exploit cucumber fisheries would in general have more or less

administrative actions (mean: 2.6) than the best fisheries performance (mean: 4.7) (Purcell, 2013) and this is stressed to have numerous administration estimates that are effortlessly comprehended then implemented (FAO, 2010). This is proposed that the adaptability of sea cucumber fisheries will be conceivable if fishermen are within a part of the administration framework and adjust rapidly to variability of the resource (Andrew et al., 2007). Sea cucumbers were conserved by the declaration of various schemes in the Indian Council of Agriculture Research (ICAR) during the period of 1962 (Asha et al., 2017). The organization has completed research on taxonomy, biology, zoogeography, bio-harmfulness, parasites, environment and cultivating of sea cucumbers (Rao et al., 1991). The CMFRI (Central Marine Fisheries Research Institute) of ICAR had increased the production of quality seeds of *Holothuria scbra,* one of the high valued organisms all over the world in 1988 for its commercial importance due to high market demand and delicate taste qualities (James et al., 1994) and organized the workshop in 1989 on the basis of national need of sea cucumber. In 1992, the committee organized another programme for fisherman to train them on the appropriate technique to handle sea cucumber from catching to selling with low price for their large benefit (Asha, 2005). Sea cucumber aquaculture has also been started to establish since 2001 through the financial help of various organizations, while they cultured the most popular species *H. spinifera* (Asha and Muthiah,

2005). In order to undertake effective management measures by fishers, buyers, academicians and researchers, this organization has urgently distributed in excess of 250 research papers, 4 unique publications and few handouts, which are closely associated to the overexploitation of sea cucumber species. Additionally, authoritative issues should need to be implemented on evaluations and benchmarks, for example, the use of 'good assembling practices' and 'peril examination basic control point' strategies. On the other hand, due to growing global interest, the new sea cucumber products are the state of fascinating advancements. Obviously, free market activity issues can't be seen in confinement. Accordingly, sea cucumber could contribute to the national economy through the creation of employment and export earnings. However, a good number of works on the biology, ecology, biodiversity, reproduction, aquaculture and conservation of sea cucumbers have been done but a very few studies have been conducted on the economic aspects such as product development, marketing, trade and business. Considering the high international demands as well as high nutritional and commercial values, the present work has been focused on the following:

2 Specific Objectives

To assess the status, prospects, potentials and importance of sea cucumber fisheries in the Indo-Pacific countries.

To investigate the marketing opportunities and challenges with special emphasis on their proper utilization and trade in the region.

3 Methodology

3.1 Methods of the Study

A comprehensive literature reviews as well as relevant information/data using electronic databases on sea cucumber fisheries from different aspects were investigated. The study additionally gave a combination of outcomes and exchange on accessible papers about the sea cucumber. The primary emphasis was given to collect the relevant published information and data from South and East Asia. The second part discussed about the product promoting as well as difficulties in growing sea cucumbers in the area. The third part gave a combination of normal displaying matters, and dealt with an arrangement of suggestions on the most appropriate method to investigate the odds, defeat the difficulties, and manage the different issues perturbing the sea cucumber industry in the area.

We incorporated a wide range of relevant investigations like diary articles, reports, books and book chapters with respect to our subject of study. Also the necessary information and need-based

data were collected through the online investigations as well as asking questions to the stakeholders. At first, we perused every one for their improved works to pass through the judgment on the reasonableness of the investigations and after that all the appropriate references were added to the articles. Next, we recuperated and saved the full messages with the selected references. Additional knowledge and updated information were also gathered on the subject matter from the library database. In total, 78 articles were evaluated, of which 60 articles were at last utilized in this thesis (Fig. 1). The articles which were not relevant with the present work as well as not composed in English, were finally discarded.

3.2 General Flow Chart of Literature Review

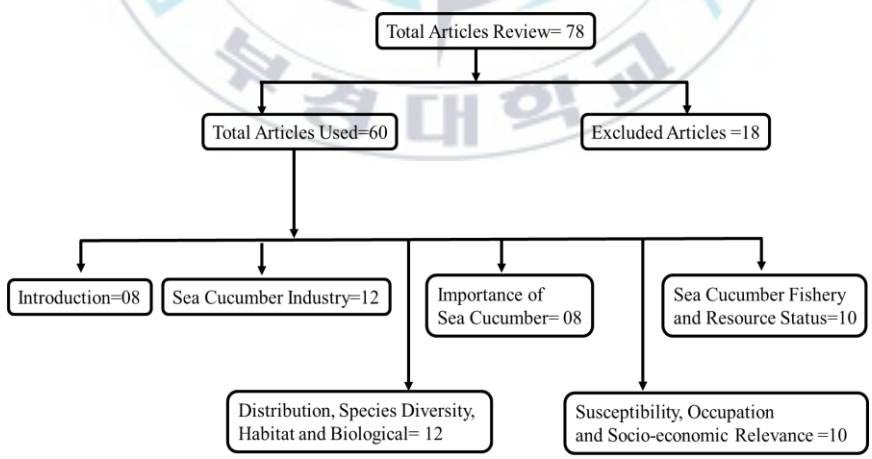

Figure 1. Infrastructure of literature review

4 Results and Discussion

4.1 An Outline of Sea Cucumber Trade

The sea cucumbers are found in the seafloor world-wide. A total of 1200 sea cucumber species were identified in the world among which 49 species are found in New Zealand waters (Pawson, 2007). The production of world sea cucumber increased from 130,000 in 1995 to 411,878 tons in 2014 (Rahman and Yusoff, 2017). Worldwide, this fishery supplies crude sea cucumber from bases to the several regions of the world aimed at handling into beche-de-mer. During the period of nineteen centuries, a growing increase in the interest for large sea cucumber combined with a decrease in supply, encouraged the investigation into the fishery of the commercial species (Preston, 1993). This reclassified the global limits of the beche-de-mer business and redirected some enthusiasm from the typical species (primarily tropical or antiquated northern fisheries), to the investigation of novel, already unutilized, tropical and calm types, for ex-adequate; *Stichopus californicus* and *S. parvimensis* on the Washington drift

(Conand and Byrne, 1993). A widespread sea cucumber fishery in many regions has a TAC (add up to permissible catch) of 500 tons every year. As one animal type is focused on and angled out, different species are looked for, with the final product existence the complete abuse of this species. Eventually, the major species being focused on the dark nipple angle (*Holothurian nobilis*).

4.2 Importance of Sea Cucumbers

4.2.1 Commercial valuation of sea cucumbers

Around 60 species of sea cucumbers are commercially collected over 70 countries in the world. In spite of the fact that the business of this animals varies from species to species, sea cucumber fisheries advocates to an essential part of costal job and provide work to three million fishers around the world (Feary et al., 2015; Purcell et al., 2014). The Indo-Pacific area is an imperative house of sea cucumbers. Somewhere in the range of 1996 and 2011, the region represented everything except one of the main five sea cucumber producing countries (in light of import information to Hong Kong). However, the production volumes of sea cucumbers in several countries (viz., Japan, Indonesia, Philippines, Fiji, Papua New Guinea) have been declining due to over-exploitation and lack of conservation strategies (Purcell, 2013; Purcell et al., 2014).

The body of sea cucumber is overwhelmingly traded as dried from, beche-de-mer (BdM), which includes 99% of all worldwide sea cucumber products (Anderson et al., 2011). Once rehydrated, this item is enthusiastically consumed for its therapeutic advantages and includes as one of the five basic indulgence commodities in Chinese traditional meals for serving in special occasions, such as for the Chinese New Year celebration (Purcell et al., 2012; Purcell, 2014). The ongoing advancement of Chinese markets has caused an emerging extension of these fisheries (Eriksson and Clarke, 2015; Anderson et al., 2011).

Hong Kong (HK) has always been the center of BdM imports, marketing and trade. Nonetheless, in the previous ten years, the development of other trading center has caused a decrease in its relative piece. These include Singapore, Taiwan, Japan and Korea (Purcell, 2014). Approximately, 80% of BdM from HK is re-traded, 90% of which is bound for China (Ferdouse, 2004). In 2007, HK imported a total of 5,296 tons of dried sea cucumbers from 58 nations. These sea cucumbers were then re-exported to 13 nations, including China (Akamine, 2004).

4.2.2 Dietary Importance

Sea cucumber are economically important for their dietary and recuperative commodities. Many of them are additionally collected

for ornamental purposes (Dee et al., 2017). In the business perspective, price of sea cucumbers is fixed on the basis of size, shape, color, appurtenance, taste, demand and market values. In Korea and Japan, the cleaned body walls of the sea cucumber animals are eaten crude or cured, and the particular parts are consumed from the reproductive systems, gonadal tissues and guts (Conand and Sloan, 1989). As of health perspectives, sea cucumbers are very rich in essential protein, low fat, and also have a complete profile of nutritional supplements, for example, Vitamin A, B_1 (thiamine), B_2 (riboflavin), B_3 (niacin), and natural resources, particularly calcium, magnesium, iron and zinc (Bordbar et al., 2011).

4.2.3 Medicinal importance

Notwithstanding for health benefits, sea cucumbers have for long time being considered as the traditional medicine for the peoples of Asian countries. Historically, the Chinese peoples utilized sea cucumbers for treating physical weakness, malnutrition, constipation, intestinal dryness, kidney disorders and frequent urinations. Latest researches have shown that sea cucumbers contain valuable bioactive compounds, which have angiogenic, anticancer, anticoagulant, antihypertension, antimicrobial and antidiabetic activities (Bordbar et al., 2011; Rahman, 2014). It also

contains higher amounts of mucopolysaccharides, such as chondroitin sulfate, which is recognized for diminishing the joint inflammation and suppress infections, for example, treatment of herpes and HIV. In addition, sea cucumbers are also currently being used for important marketable items such as body washing cream, moisturizer, soap, toothpaste etc. (Bordbar et al., 2011) as well as some other noticeable items, for example, Arthi Sea, Sea CuMax (joint pain drug), and Sea Jerky. Because of these nutritional and therapeutic health benefits, sea cucumbers are considered as one of the promising area of research (Roginsky et al., 2004).

4.2.4 Ecological Importance

Due to the omnivorous nature and predominantly detritus feeder, the sea cucumbers play a significant role in cleaning the sea floor by consuming the decomposed materials and thus maintain the suitable aquatic habitat for the growth and production of other bottom-dwelling marine organisms such as corals, sea urchins, bivalves, etc. As bottom feeders, they also maintain excellent seawater quality through influencing the carbonate substance and acidity of water (Massin, 1982). They also support CaCO3 to the coral reefs and act like a characteristic natural element to buffer the acidic environment and also help in the recycling of suspended matters (Haemel and Mercier, 1998). Sea cucumbers also help to separate natural ingredients and reorganize the supplements to the

marine water column subsequently by counteracting hypoxia and thus extra lethal materials going down into the silt. Once they suck sand, the normal stomach related procedures in gut enhance the pH of water on the reef where they excrete, disputing the adverse impacts of sea acidification. The alkali squander created of the process when silt likewise attends to treat the encompassing territory, giving supplements to coral development and improve profitability and takings of benthic linkages (Wolkenhauer et al., 2010). Consequently, its improper use might cause prompt aberrant impacts on the sea bottom environments (Uthicke, 2001; Purcell, 2014).

4.2.5 Economic importance

Within the period of imposing ban, sea cucumbers were typically harvested by snorkeling, shallow-water diving as well as taken as by-catch from trawling. Catching by skin-diving was commercially effective than different methods of fishing as the expense of activity and operation were low. In any case, income was five times higher than the operational expenses throughout the pre-ban period, which was lessened to about 3.0 times in the ban time, meanwhile people were getting less prices during ban period. In addition, the majority of the collectors were selling freshly-caught sea cucumbers in the period of prohibition during which they get low price (BOBLME, 2015).

4.2.6 Sea cucumber fishery and resource status

4.2.6.1.1.1 Fishery

The sea cucumbers focused on the size range between 5 cm and 1 m are considered for beche-de-mer (Conand, 1993). We usually found it into the aquatic environment such as reef beds and grass beds. Fishers collected by hand utilizing snorkel and plunging gear and lift bags for more deep reef and tidal pond situations. They are indispensable resources for shoreline livelihoods and systems. Most of the Asian market are involving to trade and process of sea cucumber which at least 60 species from 40 countries (Conand, 2006). The retail prices of sea cucumber up to USD 300-500 per kg from dried. In recent year, it is starting to diploid for over fishing. Sea cucumber fisheries are divided by scale of fishing activities, stock and management agency. Some management measures have been taken by government of developing countries for some fisheries but most of them are still overfishing. Improve knowledge of sea cucumber fisheries is a vital factor for management. Government should take stick decisions, intensive measures, provide alternative income sources to the fishers and impose enforcement (when necessary) for proper management, utilization and conservation towards sustaining the sea cucumber populations for present and future generations (FAO, 2010).

4.2.6.1.1.2 Growth of sea cucumber fisheries

Harvesting and sun drying of sea cucumbers to produce the dried

body mass ("bêche-de-mer"), had begun in the Asia-Pacific region more than 300 years ago (Conand, 1990). The Chinese privileged society looked this product for their medical advantages and health welfares (Pawiro, 2008). The advancement of the trade pursued the marine bioresource investigation and extension at the time with marketing personnel living local trading stations channeling trade from far areas to China (Conand and Sloan, 1989). Assisted by the basic drying technique required to conserve the product, and the high economic value, the trade with sea cucumbers extended until the mid-1900s, when the fishery declined and remained to a great extent idle throughout the world wars and China's marginalization in worldwide business (Conand, 2017). Nevertheless, in the mid-1960s the sea cucumber trade recaptured a portion of its significance and with reform of China's outside market approach and joining into the world economy during the 1980s, the market for sea cucumber extended quickly into formerly unfished areas (Kinch et al. 2008).

Today, it is assessed that more than 3 million individuals around the globe take an interest in various sorts of sea cucumber fisheries focusing on in excess of 60 species on all main lands, dominatingly to produce bêche-de-mer for the Chinese dried fish market (Purcell, 2010). In the tropics, sea cucumbers are by and large sourced from close shore regions utilizing straightforward accumulation strategies, for example, gathering or breath hold jumping, making this asset accessible to a wide portion of the

fishing network. The fishery has truly determined remote town economies (Friedman and Chapman, 2008) and all through its improvement it has given methods for money and action in minimal and poor territories (Toral et al. 2008), and even invigorated societal recuperation in misfortune zones. Sea cucumbers are a portion of the world's most high-valued marine products and in some Pacific islands the export-earnings from sea cucumbers have outperformed that of fin-fishes and other marine bioresources (Purcell 2010), showing the high value of the product and significance to local economies.

4.2.7 Susceptibility, occupation and socio-economic relevance

4.2.7.1.1.1 Global over-exploitation and susceptibility of sea cucumbers

The simple collecting method and least effort during handling has increased the sea cucumber fishing and trading in the Indo-Pacific regions. Insufficient management measures, anthropogenic catastrophes as well as over fishing of commercial species make the extreme changes and severe depletion of sea cucumber population that highly impacts on the global economy and trade (Sastry, 1998). Basically, collectors without much of a stretch can successfully catch the surface water holothurians from their natural habitats (Uthicke and Benzie, 2001). Furthermost, tropical sea

cucumber species will in general happen in surface seawaters inside the breaking point of breath hold diving (Kinch et al., 2008). Due to the sessile mode of nature, sea cucumbers are unable to escape rapidly from patches of high thickness and once distinguished, they are subsequently and effortlessly caught by fishers. Soon after the embryonic and larval phase, moderate development, benthic life span and low rates of deployment make a few animal groups (including sea cucumbers) incapable against over fishing and thus hinders the restoration of depleted population.

4.2.7.1.1.2 Global trading of sea cucumbers

The graph shows the trend in the export of ‘beche-de-mer’ from India during 1992 to 2014 (Fig. 2). In 1992, the amount of prices per kg stood at approximately zero. The prices rose steadily to 10 Rs by 1997 and then more sharply to about 400 Rs in 2005. At this point the prices of per kg increased until Rs 60 before touching the highest level Rs 140 per kg by 2014 (Asha et al., 2017). In view of the ban, fare of 'beche-de-mer' endured a serious difficulty in 2009 and declined to 37.14 t from 47.84 t in 2008 (Fig. 2).

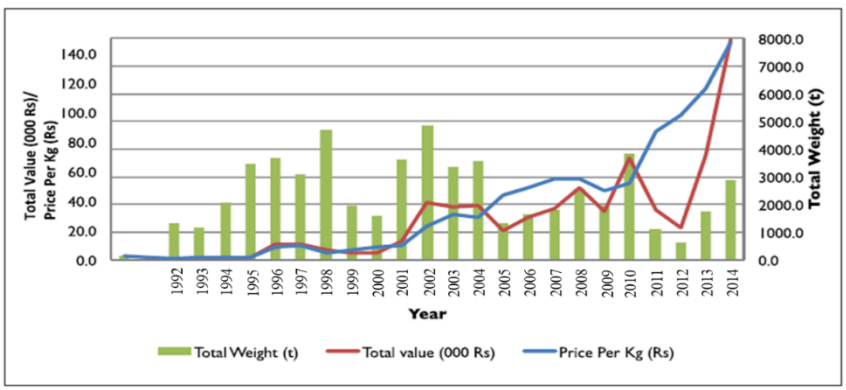

Figure 2. Trend in the export of ‘beche-de-mer’ from India during 1992 to 2014

Sea cucumber were usually banned by their size in the off seasons. They were mainly banned between 2" and 3" size during harvesting season because of overexploitation. Around then, no nation had limited the body size for export and subsequently, different nations were exporting size underneath 3". From the examinations of business solicitations of exports for the period from 2006-07 to 2010-11 it has been observed that the size beneath 3" represented for 49 to 87% (Fig. 3). During the fiscal year 2010 to 2014, the exports grabbed because of the additional exertion put by the dealers to get material from different places because of the higher cost offered (Rs. 86 to 148 for every kg) of 'beche-de-mer.'

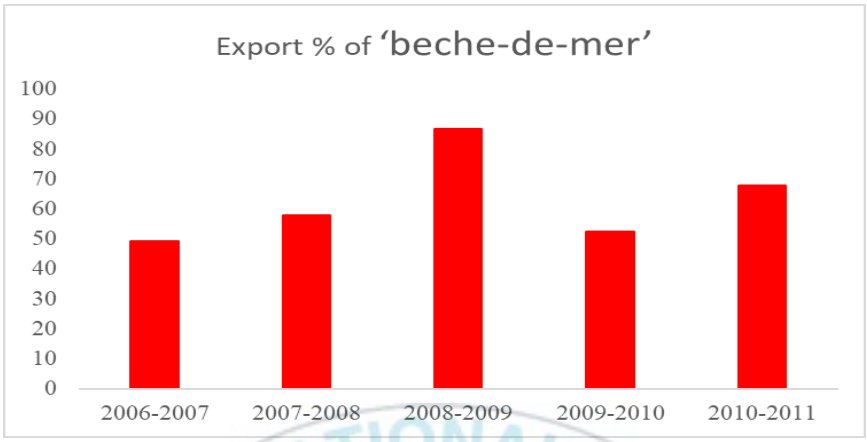

Figure 3. Percent export of 'beche-de-mer' < 3'' size from India (Asha et al., 2017)

The export figures from 2009-2010 to 2016-2017 shows a gradual decline to 11 t during 2002-2003 from 123 t in 2009-2010 (Fig. 4). The export value increased from 2009-10 to 2012-13 with a regular price of Rs 275.5 per kg nonetheless during 2016-2017 the normal value was advanced (Rs 567 per kg (Asha et al., 2017).

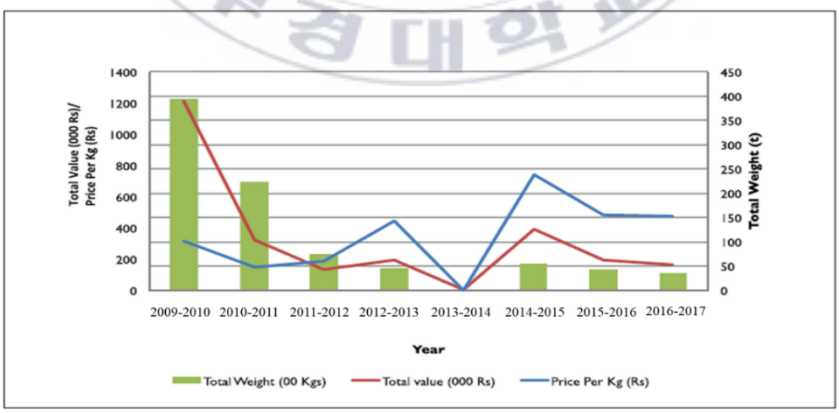

Figure 4. Trend in the export of 'beche-de-mer' from India during 2009-10 to 2016-17

4.2.7.1.1.3 Changing livelihood pattern of fishers during fishing at ban period

Around twenty thousand people were engaged with sea cucumber fishery and more than fifty thousand (counting fishers, mediators and brokers) were profited from this fishery in the Gulf of Mannar and Palk. In 1982 prohibition on the export of the prepared holothurians of under 3" size somewhat influenced the occupation of fishers. Notwithstanding, the 2001 cover boycott completely influenced the business of thousands of fishers' families associated with sea cucumber fishing. There was a misfortune in their normal pay as they were not ready to do other fishing exercises because of absence of limit with respect to venture. As a result, their obligations expanded and they were not able give quality instruction to their youngsters. They likewise discovered trouble in masterminding relational unions of their girls. A couple of fishers moved to different areas and states looking for occupation after usage of the boycott (BOBLME, 2015). Denied fishers and brokers of this district made a few portrayals to the Government of India, asking for to boost the boycott and to permit fishing of sea cucumber. As there was no optimistic reaction from the Ministry, the fishers and dealers have as of late moved toward the legal. As the boycott has influenced a large number of fishers' families, they need the boycott to be lifted at any rate for a couple of industrially vital species. They are pleasant to pursue administrative measures

like size limitation on fishing of undersized sea cucumbers, prohibition of broodstocks from fishing, controlling from utilization of ruinous fishing gears, restrictive fishing ban period for stock increment, sea farming and stock improvement programs.

4.2.7.1.1.4 Economics Aspects

In the ban time, the sea cucumbers were for the most part harvested by diving. Catching of sea cucumbers by diving was monetarily most proficient method than different methods due to lower operation and investment expenses. Notwithstanding, the revenue remained multiple periods the working expenses during the pre-ban time, which has decreased to 3.1 occasions in the ban time, since fishers are getting reduced cost at the ban period. In addition, the greater part of the fishers was selling freshly-caught sea cucumbers during ban for which they get less prices (BOBLME, 2015).

Over the most recent fifteen years of ban, the price of sea cucumbers has increased 2 folds in each level of the supply chain. The price increased because of the increasing demands in the global markets. The market price of bigger sea cucumbers was usually 2-2.5 times higher than the smaller ones (Table 1). The fishers get around half of the estimation of sea cucumbers previously and during the ban. Exporters get maximum benefit who sold the products usually for Rs.10, 500 by contributing just

Rs 6,200, i.e., a benefit of about 69% over the expenses incurred. Moreover, during the ban, the net benefit (% over total expenses) is similarly dispersed along the market chain. The reasons behind this might be due to the panic that all are engaged in unlawful exercises and would prefer not to be uncovered. However, the traders were not ready to give the export-price to the fishers/middlemen before and after imposing the ban.

Table 1. Regular market price for handled sea cucumbers across the supply chain (Asha et al., 2017).

Level of supply chain	Earlier ban (cost per kg)		Later ban (cost per kg)	
	21 counts	46 counts	21 counts	46 counts
Fishermen	4,000	1,800	8,000	2500
First man	4,200	1,908	8,500	2,900
Second man	4,900	1,999	9,500	3,700
Third man	5,800	2,300	10,90	4,900
Seller	6,300	3,700	14,500	6,900
Trader	9,800	4,000	16,000	10,700

4.2.7.1.1.5 Prime function of the business system in South-East Asia

The key frameworks for sea cucumber business are mainly depended on the supply, request and cost. Supply incorporates accumulation from the wild and creation from lakes, yet isn't constrained to these. All activities associated with preparing, delivering and disseminating of beche-de-mer products accessible to customers are additionally seen in the published work of Perez and Brown (2012), as a major aspect of supply. Demand is evaluated on the basis of the utility inferred in consumption and as far as its spatial and transient nature The marketing networks as well as the price of the beche-de-mer products are constrained to investigate of premium price for quality, value spreads and value patterns.

4.2.7.1.1.6 Supply-related marketing system characteristics

There are various ongoing networks that keep running across South-East nations with regards to market-related supply framework for beche-de-mer products. Majority of the nations in the area are prime sources of sea cucumber items, and the product outlines are pretty much since the country have a comparative tropical condition. Harvesting of the amounts from the wild is more or less minimal, and conducted generally by low-wage

families inhabiting near coasts. Initial handling stays customary, and processing systems for the most part are similar over the area. Overexploitation of commercially important species is a typical issue, with every nation taking particular activities to address the issue. At the long last, all nations are investigating about the sea cucumber culture as a noteworthy supply basis to enhance the salaries of th coast-inhabitant families and reduce the unstrained exploitation in nature (Gamboa et al., 2007).

4.2.7.1.1.7 Marketing distribution system

Production of sea cucumber in South-East Asia is for both household utilization and the international business markets (SEAFDEC 2009). Be that as it may, the variations between the local and export market depends upon the countries from where it came from. Nations with little demands such as the Philippines, Indonesia and Cambodia (Wiadnyana 2009), wherein the greater part of production is exported and other utilization is constrained to neighborhood Chinese inhabitants. Noteworthy neighborhood markets exist just in Vietnam and Malaysia. The overall sea cucumber market flow encompasses fishers, local collectors and processors, other dealers in the source locations, and exporters usually situated in large towns (Fig. 5).

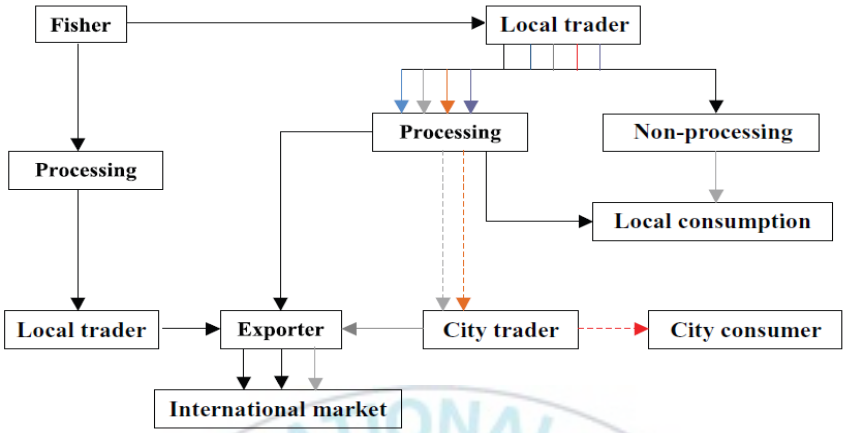

Figure 5. Marketing system of sea cucumber from fisher to International Market Source: SEAFDEC (2009)

Firstly, fisher catch the sea cucumber and sell (either in fresh or dried form) to local buyers/traders (who also purchased directly from fishermen) with an option to dry by themselves. Both the village-level collectors and field-based processors are existed in the harvesting areas. Local traders are selling in two ways such as local trader to exporter or after processing to city trader than exporter. Finally, after collecting of all products from local traders, exporters then sell it to the International market (Figure. 6). The domestic markets also sell sea cucumbers to the local processors for manufacturing conventional medicines and other products associated with the health benefits. Nevertheless, a main portion of sea cucumber in Malaysia is exported for international market.

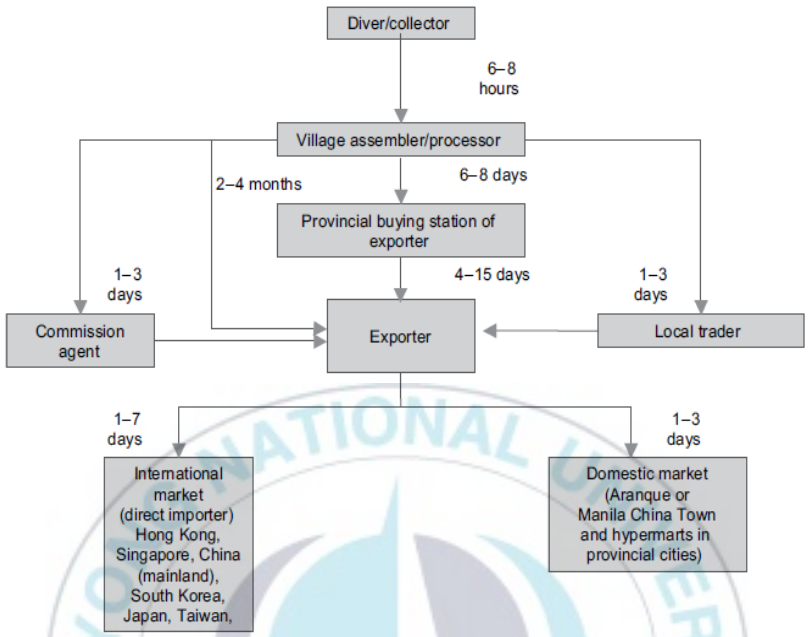

Figure 6. Key steps of sea cucumber from primary to tertiary level (Brown et al. 2010)

4.2.7.1.1.8 Marketing system related with demand

Among the Asian countries, demands for sea cucumbers are mainly raised from the higher and middle classes, particularly in China and Japan. Conventional knowledge on sea cucumber as a biomedicine and has been prescribed for minor injuries (e.g., crude cuvirian tubule of sea cucumber was used as crude plaster for minor wounds healing). Sea cucumber extracts are also utilized for the treatments of tumors, parasitic diseases, hypertension, high blood pressure, cardiovascular disease, arthritis pains, kidney

disorders, joint inflammation and so on (Trinidad-Roa 1987; Bordbar et al., 2011; Rahman, 2014; Rahman and Yusoff, 2017). In international business perspectives, Hong Kong represents the main global market followed by that of Singapore. Instead, for the most cases, Hong Kong re-exports beche-de-mer to China. The sea cucumber product types, volumes and values for world trade are presented in Table 2. The world business with sea cucumber commodities keeps on expanding as the price for the product increases through time, being the Chinese population comprising the main customers.

Table 2. Sea cucumber business over the world (Brown et al., 2010)

Features	Year		
	2005	2006	2007
Fresh, live and freeze (weight in million tons)	56	34	67
Price (US dollar in thousands)	369	388	417
Dry and brine products (weight in million tons)	6,463	4883	5,734
Total price (US dollar in thousands)	44,215	42,021	55,852

A remarkable feature of sea cucumber market in Hong Kong is the rising of medicine and herb shops where different types of sea cucumbers and their beche-de-mer products are kept and demonstrated in large transparent glass/plastic jars for selling (Fig. 7 and Fig. 8). The commercially important species of tropical sea cucumbers such as *H. fuscogilva*, *H. scabra*, *H. whitmei*, *Actinopyga lecanora* and *Thelenota ananas* are usually displayed in these shops, the sell prices of which varies significantly from HK$ 1,300 to HK $1,600 considering the stated sell between 6 and 7 kg per day.

Figure 7. Herb and medicine store of sea cucumber in Hong Kong

Figure 8. Sea cucumbers on display in a herb and medicine store, Hong Kong

Generally, sea cucumber market in Hong Kong, could be described as

Having:

- A great inclination for certain species, among which *Apostichopus japonicus* is considered as the most lucrative species, and is retailed up to HK$ 58,000/600 g in the medicine and herb shops. Other species such as *Holothuria fuscogilva*, *H. scabra H. attra*, *H. whitmaei* and *T. ananas* are also considered to be high-valued.

- A noticeable emphasis for the origin of the beche-de-mer products, along with the common indication that the sea cucumbers which are selling in the shops have been originated from Japan and therefore rarely recognizing the vast importance of the products from the South-east Asian region.
- A clear liking for the size, shape and quality, causing in an extensive price series, despite within a particular species (Table 3).

Table 3. Range of retail prices for dominant sea cucumber species in South-East Asia

Sea cucumber species	Value range (USD)	Sea cucumber species	Value range (USD)
Stichopus hermanni	62.50	*Holothuria edulis*	8.00–22.50
Stichopus chloronotus	21.25–65.00	*Stichopus variegatus*	6.75–62.50
Holothuria nobilis	20.00–78.95	*Actinopyga mauritiana*	5.00–15.00
Bohadschia argus	20.00–30.00	*Holothuria sp.*	4.75–44.00
Apostichopus japonicus	17.50–112.50	*Actinopyga echinites*	4.50–57.50

Holothuria fuscogilva	15.50–95.00	*Thelenota anax*	3.68–60.00
Thelenota ananas	12.50–67.50	*Holothuria rigida*	3.00–59.00
Holothuria scabra	9.00–112.50	*Holothuria impatiens*	2.50
Actinopyga lecanora	8.00–71.25	*Holothuria atra*	1.75–22.50
Actinopyga miliaris	8.00-–44.00	*Pearsonothuria graeffei*	1.75–5.00
Bohadschia marmorata	1.40–23.75		

Source: SEAFDEC (2009)

4.2.7.1.1.9 Price-related Marketing System Characteristics

As specified, price-behaviour gives a depiction of the general market status and business target. Two critical qualities of the sea cucumber marketing structure observed that can be depended on price behaviour are feasibility and reliability. Not at all like the prices of most other fishery or agriculture products, which display high seasonal changeability, have the prices of sea cucumber been steady for as far as 5 years. This is notable to bear in mind that sea cucumber accumulation to some extent is largely

seasonal (Perez and Brown, 2012).

Also, values depend on the species, size and quality. Mean price-data based on time-series (i.e. mean of the different species) however basically do not have analyzed values. Price behaviour through time series can be determined just for similar species having a place with a similar size and quality arrangement. An appropriate arrangement of valuable and informative data on sea cucumber prices covering the value ranges of a few species categories that traded in the Philippines between 2000 and 2007 is reported by Perez and Brown (2012).

4.2.7.1.1.10 Marketing Challenges

Sea Cucumber is playing a key role in the world food export and import. It is not only used as a luxury commodity in the developed countries but also acts as a staple food in some the developing country. The trade of sea cucumber is increasing day by day because of its high demand such as nutritional value as well as medicinal significance. As a result, overexploitation have recently been started in some south Asian countries (Valdimarsson, 2007). Sea cucumber is also popular for its' dry beche-de-mer product because of the market preferences of this natural resources and it has been extended to many exported market in the entire Asia. Due to the over exploitation, government must have to need some strict decision as well as undertake appropriate management

strategies for sustainable sea cucumber fisheries and aquaculture. The price of sea cucumber is mainly size depended such as the large size carries the high price and small size sell in the lowest prices (Purcell, 2014). Sea cucumber production is increasing extensively in South-East Asian regions due to the application of improved Aquaculture techniques, which help to reduce the difficulties of availability of this product. The most growing country like Philippines, which is extensively selling sea cucumber in the world market because of favorable environment and the improved hatchery technology. Moreover, the supply chain system fully depended on three layers such as collector, processor and exporter but there are other extra layers including brokers and commission specialists. Sometimes, these products are including extra price to byer because of the handling costs. Finally, the prices of sea cucumbers are increasing because of high labor cost and are also getting popularity due to high market and trade potentials. There are still some difficulties that must be addressed and solved by the South-East Asian nations in order to get complete profit from the enhanced sea cucumber production due to the implementation of improved aquaculture technology (Perez and Brown, 2012).

5 Conclusion

In conclusion, the findings emerged from the present work revealed that the sea cucumbers are not only play significant roles towards the fulfilment of beche-de-mer market demand but also have a crucial importance for the biodiversity conservation. This study also demonstrated that illegal trade might have adverse impact on sea cucumber populations and therefore, government needs to take strong initiatives to conserve high-valued sea cucumber species from extinction. Finally, government and associated organizations/departments urgently have to make significant roles for the sustainable exploitation, proper management, effective utilization, improvement of fishers livelihood and their socio-economic status, conservation of sea cucumber stocks, and foreign exchange earnings in commensurate with the national and international perspectives.

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