



Growth performance and competitiveness of finfish and frozen shrimp exports in Sri Lanka

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ABSTRACT

Frozen shrimp and finfish are important export products in Sri Lankan economy. Careful evaluation of growth trends and competitiveness of these products is important in further value chain development and sustainable economic profits. The present study examined the growth performance and export competitiveness of frozen shrimp and major finfish exports from Sri Lanka during 2000-2015. Analysis of finfish exports showed that bigeye tuna (*Thunnus obesus*) and yellowfin tuna (*Thunnus albacares*) were dominant export products. Compound growth rate analysis (CGR) of frozen shrimp indicated that there was a negative growth rate in terms of both export value (-9.3%) and export quantity (-9.07%) during 2000-2015. Fresh chilled fish, frozen fish and fish fillet and other meat have shown positive growth rates in export value (5.09, 10.24 and 70.10% respectively). However, considerable instability (11.07 and 11.74% in terms of value and quantity respectively) was recorded in fish fillet and other meat. Export competitiveness index (*XCI*) for fresh/chilled fish, frozen fish and fish fillet showed positive competitiveness ($XCI > 1$) during 2001-2015. Revealed comparative advantage (*RCA*) for finfish exports have shown strong competitiveness ($RCA \geq 4$) during 2000-2015. Frozen shrimp exports were weakly competitive ($1 < RCA \leq 2$) during 2008-2015. Finfish exports have shown significant positive growth ($p < 0.05$) in unit value realisation while frozen shrimp exports have shown non-significant ($p > 0.05$) negative growth in unit value realisation. Expansion of export markets for Sri Lankan seafood products, value addition, compliance with international standards and diversification of shrimp exports are important further steps to sustain the competitive position of Sri Lankan fishery exports.

Keywords: Export performance, Frozen shrimp, Sri Lanka, Tuna

Introduction

Sri Lankan economy has undergone several important transitions from the era of British colonisation. During the early 1950s British introduced plantation crops (tea, rubber and coconut) which played a significant role in the export economy of Sri Lanka. However, the introduction of economic reforms/trade liberalisation in 1977, has shifted the traditional plantation-based economy towards the manufacturing and services sector (Jayasinghe-Mudalige, 2010). Moreover, this trade liberalisation diversified the traditional export products into various manufactured products (apparel, jewellery, fishery exports). Among these, fishery exports have significant importance in earning foreign exchange (NARA, 2015).

As an island nation in the Indian Ocean, Sri Lanka has great potential in exploiting its fishery resources for sustainable development. Year round decentralised fishing and fishing harbour facilities, extensive brackishwater

and freshwater resources and vast sea area (territorial sea: 21,500 km² and exclusive economic zone: 517,000 km²) strengthen the Sri Lankan fisheries sector (EDB, 2017a). The export profile of fishery products range from crustaceans to finfishes and various processed products.

Among finfishes, yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*) are the major export products. Other finfish products include skipjack tuna (*Katsuwonus pelamis*), billfish (*Istiophorous* sp., *Makaira* sp. and *Xiphias* sp.), dolphinfish (*Coryphaena hippurus*), Spanish mackerel (*Scomberomorus* sp.) and trevally (*Carangoides* sp. and *Caranx* sp.). Processed forms of tuna include tuna toppings, steaks, saku blocks and belly cube (SEASL, 2018). Among the crab species, blue swimming crab (*Portunus pelagicus*) accounted for the majority of crab exports. Crabs are mainly exported as frozen fresh crab and pasteurised crab meat. Mud crab (*Scylla serrata*) is exported as alive or as chilled fresh

crab (SEASL, 2018). Wild and cultured tiger shrimp (*Penaeus monodon*) is dominant in shrimp export while Indian white shrimp (*Penaeus indicus*) and banana shrimp (*Penaeus merguensis*) are also exported from Sri Lanka. These shrimps are exported in various processed forms such as tail on/off, stretched shrimp/Nobashi, peeled and deveined, headless and cooked shrimp. Frozen shrimp and tuna species are dominant in the export profile (USAID, 2009).

Export competitiveness at the macro/national level is defined as the country's ability to produce goods that are capable enough to compete at the world market while maintaining and expanding its real income to all its citizens (Samen, 2010). Regionally, various attempts have been made by different authors to analyse export competitiveness of agroforestry crops (Thamiam *et al.*, 2011), fish and fishery products (Shinoj *et al.*, 2009) and seafood products (Pavithra *et al.*, 2014). Results of these studies have indicated the importance of competitive products for increasing national income.

Although there is a significant contribution by Sri Lankan seafood sector towards its gross domestic product (GDP), there were limited studies on export performance and competitive advantage of fishery exports (Dahanayaka and Sivarajah, 2010; Rathnasekara *et al.*, 2017). In this context, this paper attempts to evaluate the export competitiveness, growth performance and unit value realisation of major seafood exports in Sri Lanka during 2000-2015.

Materials and methods

The analysis focused on the export data on frozen shrimp and finfish of Sri Lanka and the world during the period 2000-2015. Secondary data on total world trade and total trade of Sri Lanka were collected from the World Trade Organisation's statistical database (WTO) (<http://stat.wto.org/>). United Nations Commodity Trade statistics (UN Comtrade) (<https://comtrade.un.org>) database was

used to retrieve the export data for frozen shrimps/prawns and other finfish products based on HS classification (Table 1).

Growth performance

Growth in shrimp and finfish export was analysed using the exponential growth function (Barrows, 1996).

$$Y = ab^t e \dots\dots\dots(1)$$

where, Y is a dependent variable, a is an intercept, b is regression coefficient, t is the time variable and e is an error term.

Growth rate coefficient (b) was calculated by log-transforming the equation as follows:

$$\log Y = \log a + t \log b + \log e \dots\dots\dots(2)$$

$$\text{i.e. } Y' = A + Bt + E$$

$$B = \log b \text{ and therefore } b = e^B$$

Compound growth rate (CGR) was calculated as:

$$\text{CGR} = (e^B - 1) \dots\dots\dots(3)$$

Instability index

Instability index/Cuddy Della Valle index (CDV) was calculated using the equation proposed by Cuddy and Della Valle (Duggan, 1979):

$$CDV = CV \sqrt{(1 - R^2)}$$

CDV is Cuddy Della Valle index, CV is the coefficient of variation and R^2 is adjusted coefficient of multiple determination.

Export competitiveness index (XCI)

Export competitiveness index is widely considered as an indicator for the long-term comparative advantage of a country. It neutralises the cyclical fluctuations to a larger scale and shows sustained trends in the shifting of market forces towards new centres of gravity (Rani *et al.*, 2014).

Table 1. HS definition of major fish export products of Sri Lanka (EDB, 2020)

HS code	Product definition
0304	Fish fillets and other fish meat
0303	Fish, frozen, excluding fish fillets and other fish meat
0306	Crustaceans, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; crustaceans, in shell, cooked by steaming or by boiling in water, whether or not chilled, frozen, dried, salted or in brine; flours, meals and pellets of crustaceans, fit for human consumption.
0302	Fish, fresh or chilled, excluding fish fillets and other fish meat.
0307	Molluscs, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; aquatic invertebrates other than crustaceans and molluscs, live, fresh, chilled, frozen, dried, salted or in brine; flours, meals and pellets of aquatic invertebrates other than crustaceans, fit for human consumption.
0305	Fish, dried, salted or in brine; smoked fish, whether or not cooked before or during the smoking process; flours, meals and pellets of fish, fit for human consumption

HS0306, HS 0302, HS0303 and HS0304 were considered for the study

XCI for a certain export product was calculated using the equation:

$$XCI = (X_{ij} / X_{wj})_t / (X_{ij} / X_{wj})_{t-1}$$

X_{ij} is i^{th} country's (Sri Lanka) export of product j (either shrimp or finfish), X_{wj} is world export of product j , t and $(t-1)$ are the time for the current and previous year respectively.

Revealed competitive advantage

The degree of competitiveness/ Revealed Comparative Advantage (*RCA*) for the export product was calculated using the equation:

$$RCA = (X_{ij} / X_{it}) / (X_{wj} / X_{wt})$$

where, X_{ij} = Total export volume/value of commodity j from country i ; X_{it} = Total export volume/value of country i ; X_{wj} = Total export volume/value of commodity j from world and X_{wt} = Total export volume/value of world exports

If, *RCA* value is ≥ 1 , the share of the commodity j in the total exports of country i is greater than the world average and the country has specialised in exporting j^{th} product. If $RCA \leq 1$, the country has no specialisation in exporting the j^{th} product and no comparative advantage (Balassa, 1965). However, the Balassa index has been criticised over the years on its asymmetrical nature (if the country has comparative advantage, *RCA* is >1 ; however, there is no upper limit. Conversely when the country has comparative disadvantage, *RCA* has an upper bound of unity), issues with logarithmic transformation of the

index, unconcerned effects on various agricultural policies (Strezoska, 2015) and unsuitability in cross country comparison (Hillman, 1980). These limitations have led to various derivatives of *RCA* such as normalised *RCA* index (Yu *et al.*, 2009) and Revealed Symmetric Comparative Advantage (*RSCA*) (Laursen, 2015). Similarly, Hinloopen and Van Marrewijk (2001) classified *RCA* index into four categories to demonstrate the power of competitiveness (Table 2).

Linear regression analysis and other econometric indices were calculated using the Python programming language with the aid of *numpy*, *matplotlib* and *pandas* packages.

Results and discussion

Composition of major seafood exports

Analysis of finfish export values (HS 0302 and HS 0303) indicated that bigeye tuna (*T. obesus*) and yellowfin tuna (*T. albacares*) were dominant export products during 2000-2015 (Fig. 1).

In frozen fish group (HS 0303), the export value of *T. obesus* gradually increased and reached its maximum in 2014. Sri Lankan fishery market expansion for the European Union (EU) may contribute to increased *T. obesus* earnings starting from 2005. In contrast, *T. albacares* was the dominant export product in fresh/chilled fish exports (HS 0302). Fresh/chilled flat fish exports were also dominant in HS 0302 category during 2000-2006. Skipjack tuna (*K. pelamis*) (HS 030269) was also a prominent export product before 2008.

Table 2. Definition of *RCA* index based upon the classification by Hinloopen and van Marrewijk (2001)

Classification	<i>RCA</i> value	Definition
Classification 1	$0 < RCA \leq 1$	No competitiveness
Classification 2	$1 < RCA \leq 2$	Weak competitiveness
Classification 3	$2 < RCA \leq 4$	Moderate competitiveness
Classification 4	$4 < RCA$	Strong competitiveness

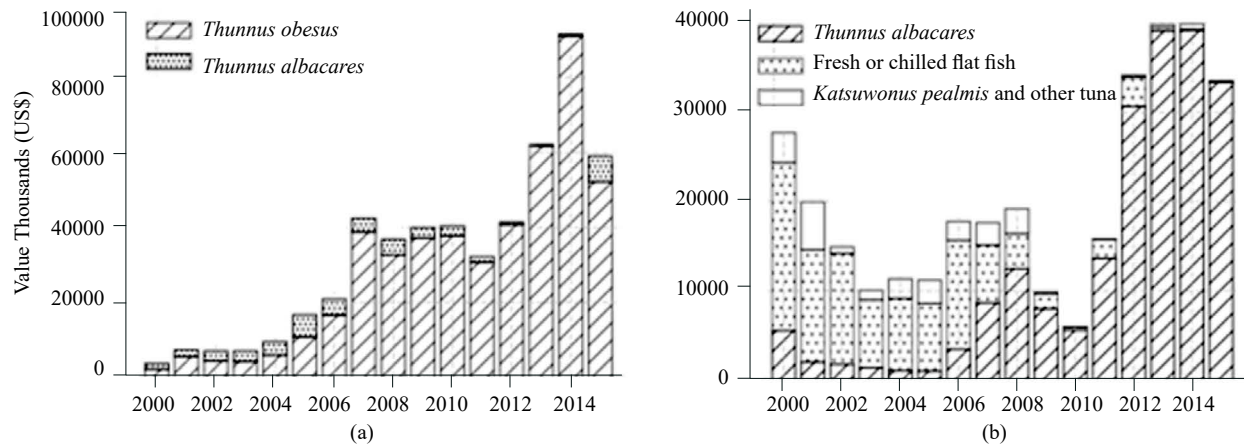


Fig. 1. Export values of (a) HS 0303 and (b) HS 0302 during 2000-2015

Sri Lankan export profile of HS 0304 category largely includes tuna fillet and meat. However, it is impossible to segregate HS 0304 category further into species level. This limitation undermines the analysis of the export pattern of HS 0304 further into species level (Gillett and Preston, 2012). Tuna steaks and frozen tuna fillet are important products in this category (Gillett and Preston, 2012). Other than the tuna species, frozen fillet of swordfish (*Xiphias gladius*) is an important export product in this group. However, data on these species is sporadically available. Though there is strong market demand, conservation status indicated that both bigeye tuna and yellowfin tuna are at a reasonable level of risk (Collette *et al.*, 2011a; 2011b). Therefore, finding a long-term substitute for tuna products and developing maricultural practices for tuna production was strongly recommended (Kulapa *et al.*, 2013).

Export trends in frozen shrimps and finfish

Export statistics of Sri Lankan finfish and shrimp exports are indicated in Table 3. Compared with finfish, the export share of shrimps in total production is declining over the years. This reduction in export volume of shrimp may have a greater influence on export earnings. Growth indices for major seafood exports of Sri Lanka indicated that frozen shrimps/prawns had a negative growth rate in terms of both export value and export quantity (Table 4).

Japan and USA are the major destinations for Sri Lankan shrimp exports (Wimalasena and De Mel, 2010). The share of Japanese market on Sri Lankan frozen shrimp reduced from 1.8% in 2000 to 0.75% in 2015. In USA, the market share of Sri Lankan frozen shrimp declined from 0.49% (2000) to 0.01% (2015) (Rathnasekara *et al.*, 2017). On the other hand, frozen fish and fish fillet and other meat showed a positive growth rate in export quantity as well as export value. Conversely, fresh and chilled fish exports showed a negative growth rate in terms of quantity but a positive growth rate in export value. EU, Japan and USA were the major finfish export destinations for Sri Lanka during 2000-2015. Sri Lanka is the second most important country for providing finfish products under HS 0304 to the European market (Gillett and Preston, 2012). The higher purchasing power of these economies may be attributable to the higher growth rate of export values (Shinoj *et al.*, 2009).

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Table 3. Export share of shrimps and finfish in total shrimp and finfish production of Sri Lanka (NAQDA, 2020; MFARD, 2018)

Year	Total shrimp exports (t)	Total shrimp production (t)	% share	Total finfish production (t)	Total finfish exports (t)	% Share
2000	4,855	11900	41	304380	11,873	3.90
2001	3,941	10900	36	284760	8,966	3.15
2002	3,202	12380	26	302890	7,724	2.55
2003	4,467	13550	33	284960	7,567	2.66
2004	2,462	12910	19	286370	8,017	2.80
2005	1,800	6250	29	163230	10,960	6.71
2006	1,837	10320	18	251270	14,301	5.69
2007	2,023	10900	19	291050	15,473	5.32
2008	854	11492	7	319120	15,014	4.70
2009	1,432	16684	9	339730	13,857	4.08
2010	1,262	21120	6	384670	13,372	3.48
2011	1,380	26830	5	440820	12,594	2.86
2012	1,078	30040	4	486170	13,228	2.72
2013	1,625	33660	5	512840	16,919	3.30
2014	2,001	29090	7	535050	18,658	3.49
2015	1,341	27180	5	520190	11,807	2.27

Table 4. Growth and instability indices for major seafood exports of Sri Lanka from 2000-2015

Product	CGR (%)		Instability Index	
	Export value	Export quantity	Export value	Export quantity
Frozen shrimps	-9.3	-9.07	2.00	2.37
Fresh/chilled fish	5.09	-2.68	2.89	5.41
Frozen fish	10.24	2.48	1.92	2.26
Fish fillet and other meat	70.1	55.57	11.07	11.74

Lack of stability in the international market prices may jeopardise the exporters at greater price risk. In terms of both value and growth, the highest instability was recorded for fish fillet and other meat. Without further decomposition analysis, the underlining cause for instability of fish fillet and meat could not be evaluated. However, EU's withdrawal of Generalised Preferential Tariff system (GSP+) for Sri Lankan exports in 2010 and depreciation of Sri Lankan rupee during 2000-2015 may be attributable to the higher instability of fish fillet and other meat. The instability could be tackled by prize stability measures and measures to stabilise the export volume (Pavithra *et al.*, 2014).

Export competitiveness index

The highest world market share for frozen shrimp exports of Sri Lanka was recorded in 2009. However, the world market share of frozen shrimp of Sri Lanka was below 1% (Anthonysamy, 2013). The negative CGR in both quantity and value indicates frozen shrimp export had lower competitiveness during 2001-2015. As a whole, during 2001-2015, *XCI* indices for fresh and chilled fish, frozen fish and fish fillet and other meat revolved around

unity, indicating positive export competitiveness (Fig. 2). Increased competitiveness of frozen shrimp export of Sri Lanka could be attained by creating/attracting high-end customer base by promoting Sri Lankan shrimps, gradual infiltration to the non-conventional markets other than the EU, USA and Japan and by setting up proper distribution channels. Cessation of the civil war in the northern and eastern part of the country has opened various opportunities for large-scale shrimp production. This might be a promising factor for increasing frozen shrimp production in the country (Thayaparan, 2014).

Revealed comparative advantage of finfish and shrimp exports

During 2000-2015, frozen shrimp and prawns, fresh/chilled fish, frozen fish and fish fillet and other meat exports have revealed their competitiveness ($RCA > 1$) (Fig. 3). As a whole, increased competitiveness of seafood exports in Sri Lanka may be caused by low-cost labour and good access to the fishery resources (De Silva and Yamao, 2004). This situation is also prominent in the seafood industry in other countries such as Thailand (Supongpan Kuldilok *et al.*, 2013).

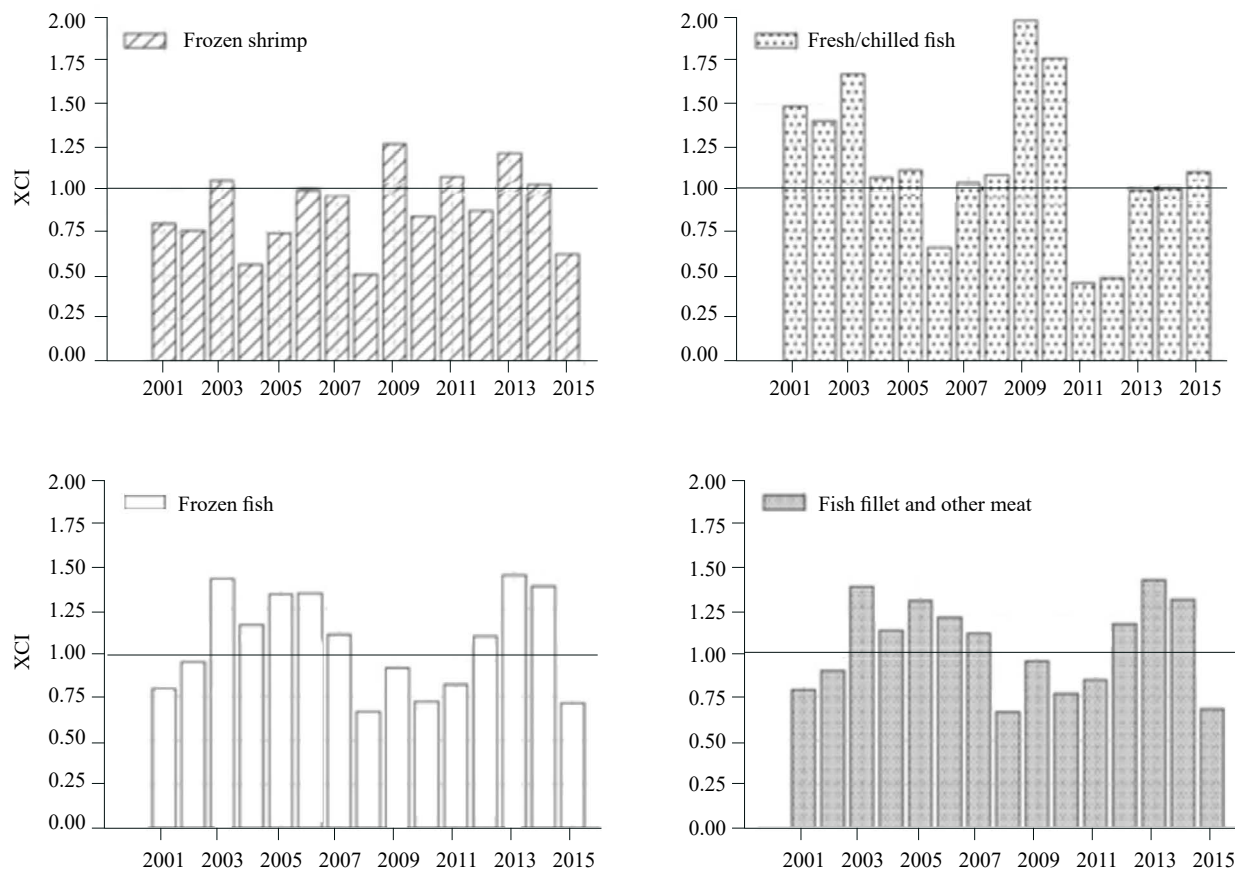


Fig. 2. Changes in export competitiveness indices (*XCI*) for frozen shrimp and major finfish exports during 2001-2015

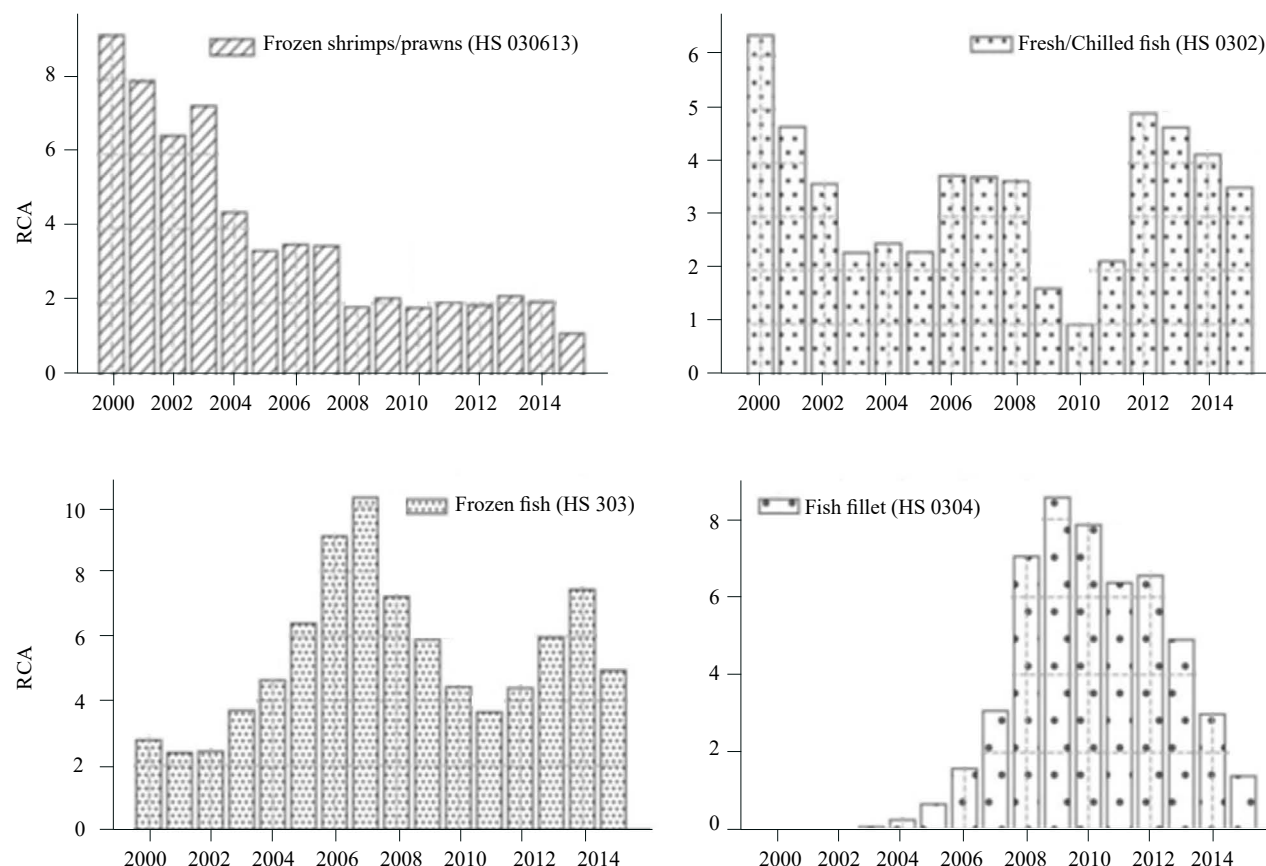


Fig. 3. Revealed comparative advantage (RCA) for frozen shrimps and major finfish exports during 2000-2015

RCA for the frozen shrimp was strongest (9.19) in 2000 and gradually it declined to the weakest stage (1.18) in 2015. During the last decade, increased competition from South-east Asian countries (China, Vietnam, Indonesia) over the Japanese market, less *per capita* consumption of frozen shrimps and prolonged economic crisis in Japan (Anthonysamy, 2013), depreciation of Sri Lankan rupee and competitive local market price for shrimp (Munasinghe *et al.*, 2010) could be attributable to the declining export competitiveness in Sri Lankan shrimp. In this context, diversification of market destinations may be important in increasing the export competitiveness (Fathima *et al.*, 2006).

Frozen fish and fish fillet and meat have shown strong competitiveness ($RCA \geq 4$). As one of the key importers of Sri Lankan fishery products, EU decisions might have significantly affected the competitiveness of major finfish exports. The EU has introduced Generalised System of Preferences (GSP+) tariff concessions on Sri Lankan exports in 2005. Followed by GSP+, Sri Lankan fishery exports has increased its competitiveness during 2005-2009. Conversely, the EU's decision to temporarily

with hold the GSP+ on Sri Lankan exports in 2010 (European Commission, 2010) and subsequent ban on Sri Lankan fishery exports due to unregulated fishing in 2015 (European Commission, 2014) have adversely influenced competitiveness in fish fillet exports during 2010-2015. Amidst the EU ban on fishery exports, frozen fish and fresh/chilled fish have gained higher export competitiveness through exporting fishery products to other countries (USA, Japan, Canada).

Unit value realisation of frozen shrimps

During 2000-2015, the CGR in unit value realisation for frozen shrimp products significantly increased in China, Denmark, India and Indonesia (Table 5). Mexico, Thailand, Sri Lanka, Ecuador and Argentina have shown non-significant growth in unit value realisation during 2000-2015. On the whole, negative/non-significant growth in unit value realisation in global frozen shrimp exports in many countries may be attributable to the increased world supply of low valued shrimp species (CBI, 2017), economic concerns of major shrimp importers (USA, Japan, EU) and import/export regulations (Pavithra *et al.*, 2014).

Table 5. CGR (%) in unit value realisation for frozen shrimp (2000-2015)

Country	CGR (%)
China	6.18*
Denmark	10.33*
Ecuador	1.90 ^{NS}
India	3.41*
Argentina	-0.25 ^{NS}
Indonesia	2.00*
Mexico	-0.28 ^{NS}
Thailand	0.97 ^{NS}
Sri Lanka	-0.25 ^{NS}

NS: Not Significant, *Value is significant at $p=0.05$ (Source: (UN, 2015))

Table 6 summarises the year-wise unit value realisation for frozen shrimp exports in major exporting countries. The higher unit value realisation for Sri Lankan frozen shrimp may be associated with high-value tiger shrimp exports. In contrast to that, non-significant negative growth in unit value realisation in case of frozen shrimps might be attributable to less value addition and depreciation of Sri Lankan rupee against US dollar. Possible measures to increase the value addition and export diversification may alleviate this issue. Shrimp shells are usually discarded by the Sri Lankan shrimp processing plants. These shells contain naturally available biopolymer, chitosan, which is a promising value-added product (Sewvandi and Adikary, 2012).

Among the finfish products, fish fillet and other meat have reported the highest CGR in unit value realisation (Table 7). Significant growth in unit value realisation of these finfish products may be associated with strong demand for Sri Lankan fish products especially in EU

(Gillett and Preston, 2012). Addressing the sustainability issues related to tuna fishing, incentives for eco-certified tuna processing plants, political reforms and stability and market expansion to non-conventional countries may significantly affect further growth in unit value realisation of finfish exports (Gillett and Preston, 2012).

Detailed analysis of finfish exports revealed that bigeye tuna and yellowfin tuna were important products in finfish exports. In terms of export quantity and export value, negative CGR of frozen shrimp was recorded during 2000-2015. Compared with frozen shrimp, fresh chilled fish, frozen fish and fish fillet and other meat have shown positive growth rates. Declining growth performance has undermined the competitiveness of frozen shrimp during 2000-2015. Therefore policy implications and product diversifications are essential in regaining the competitiveness of frozen shrimp exports. In contrast, Sri Lankan finfish exports (HS 0302, HS 0303 and HS 0304) have revealed their competitiveness in the world market. Expansion of the export markets for Sri Lankan seafood products, value addition, compliance with international standards and diversification of shrimp exports are important further steps to sustain the competitive position of Sri Lankan fishery exports.

Table 7. Growth in unit value realisation of major finfish products of Sri Lanka during 2000-2015

Export product	CGR (%)
Fresh fish/chilled fish (HS 0302)	7.27*
Frozen fish (HS 0303)	8.18*
Fish fillet and other meat (HS 0304)	11.61*

* Value is significant at $p=0.05$

Table 6. Unit value realisation for frozen shrimp exports during 2000-2015 (US \$ per kg)

Year	Sri Lanka	Argentina	China	Denmark	Ecuador	India	Indonesia	Mexico	Thailand	Vietnam
2000	13.43	7.54	4.61	3.22	7.98	6.93	9.54	13.87	10.84	9.75
2001	12.21	5.98	4.19	2.59	6.34	5.95	8.09	12.81	8.88	6.73
2002	10.19	4.78	4.42	2.47	5.53	5.29	7.47	10.85	8.33	5.97
2003	9.64	8.11	4.39	2.72	3.92	5.25	6.78	11.48	7.42	6.13
2004	9.34	7.78	4.53	2.65	4.22	5.26	6.75	10.50	6.69	6.17
2005	9.78	12.26	3.67	2.89	4.98	5.14	6.63	11.37	6.00	6.24
2006	10.39	9.43	4.53	3.01	5.01	5.81	6.94	9.06	6.44	6.19
2007	11.17	6.43	5.73	3.25	4.78	6.48	7.03	8.84	6.39	6.48
2008	12.05	8.86	4.52	4.07	5.48	6.25	7.13	9.83	6.61	6.71
2009	10.03	6.21	4.47	3.55	4.87	5.76	6.95	8.08	6.24	6.86
2010	10.79	7.32	6.05	3.67	5.60	6.14	7.95	9.09	6.98	6.14
2011	11.90	6.63	6.59	4.48	6.28	6.65	9.17	9.40	8.70	6.2
2012	12.35	6.75	7.48	9.13	6.11	6.28	8.75	9.42	8.37	NA
2013	7.89	7.07	8.63	9.53	8.23	11.17	10.75	14.70	10.31	7.89
2014	12.66	6.32	10.42	11.3	8.47	10.80	11.67	14.80	11.48	8.73
2015	10.44	7.32	10.22	9.63	6.65	8.33	9.15	11.15	9.07	9.38

NA: Not Available

Moreover, strict adherence to sanitary standards, state-of-art processing and post-harvest technologies are also imperative to sustain the competitiveness of the fishery exports.

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References

- Anthonyamy, S. M. 2013. Overview of shrimp farming industry - main producers, markets, perspectives and challenges. In: *Proceedings of 10th International farmed shrimp symposium*, 11-13 June 2013, Natal, Brazil, p.1-3.
- Balassa, B. 1965. Trade liberalization and revealed comparative advantage. *Manchester Sch. Econ. Soc. Stud.*, 33(2): 99-123. <https://doi.org/10.1111/j.1467-9957.1965.tb00050.x>.
- Barrows, O. J. 1996. Marine products industry in India. In: Barrows O. J. (Ed.), *Export competitiveness in South-east Asia - Policy initiatives and corporate actions in marine products industry*. Wheeler publishing, New Delhi, India, p. 123-176.
- CBI 2017. *Exporting frozen cultured black tiger shrimp to Europe. Centre for Promotion of Imports from Developing Countries*. <https://www.cbi.eu/market-information/fish-seafood/shrimp-products/black-tiger-shrimp/> (Accessed 12 November 2017).
- Collette, B., Acero, A., Amorim, A. F., Boustany, A., Canales Ramirez, C., Cardenas, G., Carpenter, K. E., Chang, S. K., De Oliveira Leite Jr., N., Di Natale, A., Die, D., Fox, W., Fredou, F. L., Graves, J., Guzman-Mora, A., Viera Hazin, F. H., Hinton, M., Juan Jorda, M., Minte Vera, C., Miyabe, N., Montano Cruz, R., Masuti, E., Nelson, R., Oxenford, H., Restrepo, V., Salas, E., Schaefer, K., Schratwieser, J., Serra, R., Sun, C., Teixeira Lessa, R. P., Pires Ferreira Travassos, P. E., Uozumi, Y. and Yanez, E. 2011a. *Thunnus albacares*. *The IUCN Red List of Threatened Species*. <http://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T21857A9327139.en>. (Accessed 18 November 2017).
- Collette, B., Acero, A., Amorim, A. F., Boustany, A., Canales Ramirez, C., Cardenas, G., Carpenter, K. E., Chang, S. K., De Oliveira Leite Jr., N., Di Natale, A., Die, D., Fox, W., Fredou, F. L., Graves, J., Guzman-Mora, A., Viera Hazin, F. H., Hinton, M., Juan Jorda, M., Minte Vera, C., Miyabe, N., Montano Cruz, R., Masuti, E., Nelson, R., Oxenford, H., Restrepo, V., Salas, E., Schaefer, K., Schratwieser, J., Serra, R., Sun, C., Teixeira Lessa, R. P., Pires Ferreira Travassos, P. E., Uozumi, Y. and Yanez, E. 2011b. *Thunnus obesus*. *The IUCN Red List of Threatened Species*. <http://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T21859A9329255.en>. (Accessed 18 November 2017).
- Dahanayaka, C. L. and Sivarajah, P. 2010. Is Sri Lanka's marine products exports competitive? Analysis of fisheries exports of Sri Lanka. *AGRIEAST: J. Agric. Sci.*, 9: 36-41. doi:<http://doi.org/10.4038/agri east.v9i0.19>.
- De Silva, D. M. and Yamao, M. 2004. The involvement of female labor in seafood processing in Sri Lanka: Impact of organisational fairness and supervisor evaluation on employee commitment. In: Choo, P. S., Hall, S. J. and Williams, M. J. (Eds.), *Proceedings of the Global Symposium on Gender and Fisheries, Seventh Asian Fisheries Forum*, 1-2 December 2004, Penang, Malaysia, p. 103-114.
- Duggan, J. E. 1979. On measuring the instability of time series data. *Oxford B. Econ. Stat.*, 41(3): 239-246.
- EDB 2017a. Strengths and weaknesses of the sector. *Industry capability report: Sri Lankan fisheries sector*. Exports Development Board, Colombo, Sri Lanka, p. 1-7.
- EDB 2017b. *Seafood export performance*. Exports Development Board, Colombo, Sri Lanka. <http://www.srilankabusiness.com/sea-food/seafood-export-performance.html> (Accessed 12 November 2017).
- EDB 2020. *HS definition and major markets*. Exports Development Board, Colombo, Sri Lanka. <https://www.srilankabusiness.com/sea-food/hs-definition-and-major-markets.html> (Accessed 05 August 2020).
- EC 2010. *EU regrets silence of Sri Lanka regarding preferential import regime*. European Commission. <http://trade.ec.europa.eu/doclib/press/index.cfm?id=589> (Accessed 11 December 2017).
- EC 2014. *Illegal fisheries: green cards for five countries, but red card for Sri Lanka*. European Commission. https://ec.europa.eu/fisheries/illegal-fisheries-green-cards-five-countries-red-card-sri-lanka_en, (Accessed 11 December 2017).
- FAO 2004. *National aquaculture sector overview - Sri Lanka*. Food and Agricultural Organization, http://www.fao.org/fishery/countrysector/naso_sri-lanka/en (Accessed 26 January 2016).
- Fathima, K. B., Biradar, R. S. and Salim, S. S. 2006. Growth pattern and competitiveness of Indian shrimp export trade. *Fishery Technol.*, 43(1): 99-106.
- Gillett, R. and Preston, G. 2012. Statistics on the European market for HS 0304 and related products. *Feasibility assessment of exporting products of HS Headings 0304/ 0305 to the European Union*. Pacific Islands Forum Secretariat, New Caledonia, p. 22-23.
- Hinloopen, J. and Van Marrewijk, C. 2001. On the empirical distribution of the Balassa index. *Rev. World Econ.*, 137(1): 1-35. <https://doi.org/10.1007/BF02707598>.
- Jayasinghe-Mudalige, U. K. 2010. Role of food and agriculture sector in the economic development of Sri Lanka: Do we stand right in the process of structural transformation? *J. Food Agric.*, 1(1): 1-12. <http://doi.org/10.4038/jfa.v1i1.1834>.
- Kulapa, S. K. and John, L. 2013. The export competitiveness of the tuna industry in Thailand. *Brit. Food J.*, 115(3): 328-341.

- MFARD *Fisheries statistics 2018*. https://www.fisheriesdept.gov.lk/web/images/pdf/Fisheries_Statistics_2018.pdf (Accessed 05 August 2020).
- Munasinghe, M. N., Stephen, C., Abeynayake, P. and Abeygunawardena, I. S. 2010. Shrimp farming practices in the Puttalam District of Sri Lanka: Implications for disease control, industry sustainability and rural development. *Vet. Med. Int.*, 1-7. doi:10.4061/2010/679130.
- NAQDA 2020, *Statistics*, National Aquaculture Development Authority of Sri Lanka. <https://www.naqda.gov.lk/statistics/> (Accessed 05 August 2020).
- NARA 2015. *Export of fish and fishery products. Fisheries Industry Outlook-2015*. National Aquatic Resources Research and Development Agency (NARA), Colombo, Sri Lanka, p. 6-7.
- Pavithra, S., Ananthan, P. S. and Krishnan, M. 2014. Market shares, instability and revealed comparative advantage of seafood exports from India. *Indian J. Fish.*, 61(4): 91-98.
- Rani, P., Immanuel, S. and Kumar, N. R. 2014. Ornamental fish exports from India: performance, competitiveness and determinants *Int. J. Fish. Aquat. Stud.*, 1(4): 85-92.
- Rathnasekara, H., Herath, M., Rathnasiri, S. and Walisinghe, R. 2017. *Demand for seafood exports in Sri Lanka: Has Sri Lanka gained competitiveness after the civil war (Working paper)*. <http://hdl.handle.net/10072/390485> (Accessed 17 December 2018).
- Samen, S. 2010. *Why exports matter? Export development, diversification and competitiveness: How some developing countries got it right*. World Bank Institute, Washington D.C., USA, p. 3-4.
- SEASL 2018. *Sri Lankan Seafoods*, <https://www.seasl.lk/sls.html> (Accessed 05 August 2019).
- Sewvandi, G. A. and Adikary, S. U. 2012. Synthesizing and characterisation of natural biopolymer chitosan derived from shrimp type, *Penaeus monodon*. *Tropical Agric. Res.*, 23(3): 272-276.
- Shinoj, P., Kumar, B., Joshi, P. K. and Datta, K. K. 2009. Export of India's fish and fishery products: analyzing the changing pattern/composition and underlying causes. *Ind. J. Agric. Econ.*, 64(4): 541-555.
- Strezoska, Z. 2015. *Competitiveness of Agro-food trade of Balkan countries in the world market*. M. Sc. thesis, Corvinus University of Budapest, Budapest, p. 20-25.
- Supongpan Kuldilok, K., Dawson, P. J. and Lingard, J. 2013. The export competitiveness of the tuna industry in Thailand. *Brit. Food J.*, 115(3): 328-341. doi:10.1108/00070701311314174.
- Thamiam, S., Weerahewa, J., Pushpakumara, D. K. N. G. and Singh, V. P. 2011. Trade competitiveness of agroforestry crop sector in Sri Lanka. *Tropical Agric. Res.*, 22(4): 338-347.
- Thayaparan, S. 2014. Possible interventions and strategies towards positively surprising shrimp industry in Sri Lanka. *Round table discussions - shrimp farming industry*. Coordinating Secretariat for Science, Technology and Innovation, Colombo, Sri Lanka, p.16-18.
- USAID 2009. Production, consumption and trade-exports. *Sri Lanka connecting regional economies: Marine fisheries sector assessment in eastern Sri Lanka*. Colombo, Sri Lanka, p.18-19.
- Wimalasena, H. D. and De Mel, W. D. M. 2010. Shrimp farming in Sri Lanka: Risks and returns. *Sri Lanka J. Humanit. Soc. Sci.*, 1(2): 1-7.