



Compositional analysis of live fish import trade in India

C. G. JOSHY, A. SURESH, S. K. PANDA AND C. N. RAVISHANKAR

ICAR-Central Institute of Fisheries Technology, Matsyapuri P.O., Willingdon Island, Kochi - 682 029, Kerala, India
e-mail: cgjoshy@gmail.com

ABSTRACT

The live fish import trade in India under the harmonised system (HS) code 0301 (HS-0301) increased exponentially in terms of import quantity and value during the period 2000-2019. India imported 1.32 t of live fish worth US \$ 0.017 million in 2000, which increased to 653.27 t worth US \$ 3.21 million in 2019. The import of both marine as well as freshwater ornamental fish was found to increase during the period 2013-2019. The major countries exporting marine and freshwater ornamental fish to India were Thailand, Indonesia, Malaysia, Singapore and Sri Lanka. The import of live trout and carp to India was found to be very less during the period 2000-2019. The majority of live fish import to India accounted in the subclass HS030199 since 2017, with 81.55, 91.86 and 74.03% of total live fish imported to India in 2017, 2018 and 2019, respectively. Bangladesh accounted 81.02, 87.84 and 83.11% of total import quantity and 0.74, 82.42 and 49.51% of total import value under the sub-head HS-030199 during 2017, 2018 and 2019, respectively. While import of live fish offers economic opportunities, it has the potential to bring biosecurity threats including fish pathogens to Indian waters. The economic trade-off is to be evaluated on a case to case basis supported with legal and institutional back-up. Enacting a comprehensive legal framework and creating quarantine facilities are critical in this direction.

Keywords: Compositional analysis, HS-0301, Import, Ornamental fish, Trade balance

Introduction

The live fish trade in India has undergone considerable growth and diversification both in terms of import and export. India imported 1.32 t of live fish worth US \$ 0.018 million in the year 2000, which increased to 653 t of live fish worth US \$ 3.21 million in the year 2019. This has accounted almost 493 and 177% growth over the decades in import quantity and value, respectively. Whereas, India exported almost 1844 t of live fish worth US\$ 8.77 million in 2000 and over a period of two decades, the live fish export trade has grown to 7287 t in volume, worth US \$ 46.63 million in 2019 (https://mpeda.gov.in/MPEDA/marine_products_exports.php#). The live fish export trade of India had grown almost linearly during this period of time. Prathvi *et al.* (2013) analysed the export performance of ornamental fish from India and pointed out that export trade registered a compound growth rate of 12.10, 14.40 and 2.10% in terms of export quantity, value and unit value, respectively. Both import and export trade improved the internal live fish trade in India.

According to Ayyappan *et al.* (2006), ornamental fish breeding and farming in India has emerged as one of the lucrative entrepreneurship from a mere hobby. To add to this, Marine Product Export Development Authority (MPEDA) has estimated that the internal trade of ornamental fish to be US \$ 3.26 million (<https://mpeda.gov.in/>) by 2025. With this, India contributes 1% of total

ornamental fish trade in the world. This indicates high demand for domestic rearing of fresh and marine water ornamental fish. Outlining the present status and future trend of ornamental fish sector in India, Karthik *et al.* (2019) concluded that there is tremendous scope for India to be one of the leaders in world ornamental fish trade. The major states involved in ornamental fish farming are West Bengal, Tamil Nadu and Kerala; and cities like Kolkata, Mumbai and Chennai are the major ornamental fish exporting points in India contributing almost 90, 8 and 2% of total export, respectively. The ornamental fish trade provides livelihood security to the farmers and sustainable developments to the nation. Similarly, Sinsari and Priono (2019) pointed out that there is scope for high level of profit for marine ornamental fish industry in other developing countries like Indonesia.

Apart from the internal and export trade, India also import live fish in the form of fresh and marine water ornamental fishes, carps and trout to meet the demand in the domestic market under the harmonised system (HS) code 0301 (HS-0301) and its sub-codes. Other than the import of live ornamental fishes, the Indian market finds place for importing live fishes under the sub-head HS-030199. But, there have been only a few studies which analysed the import scenario of live fish under the head HS-0301 to India. The present paper analysed the trend and composition of live fish import to India at a disaggregated level (within sub-classes of HS-0301) and

explored the market channel of live fish import to India in the sub-classes.

Materials and methods

Data and classification

Secondary data on live fish import to India under the HS code-0301 and its sub-classes were collected during the period 2000 to 2019 from the COMTRADE database (<https://comtrade.un.org/>) managed by the United Nations. The HS code and sub-classifications along with its description are given in Table 1.

Apart from the items mentioned in Table 1, India imports live broodstock of *Penaeus vannamei* (Import permit no. 950/2016/DADF DT. 12.05.2016) under the HS code-03061690 and the data were collected and analysed from TRADESTAT database (<https://tradedstat.commerce.gov.in/eidb/default.asp>) managed by the Ministry of Commerce, Govt. of India.

Estimation of growth rate

The exponential growth model given in Equation (1) was fitted to the time series data using ordinary least square (OLS) method (Montgomery *et al.*, 2008) using SAS 9.3 to estimate the growth rate of live fish import trade in India.

$$Y_t = \beta_0 \exp(\beta t) + e_t \dots\dots\dots(1)$$

where Y_t is the import of live fish under the HS code 0301; t is the time (year); β_0 is the intercept; β is the estimated growth rate of import of live fish to India and e_t is the error term assumed independently and identically distributed with mean 0 and constant variance.

Development of trade indices

Normalised trade balance index was computed for quantity and value of live fish trade under the head HS-0301 using the Equation (2) to see the trade off between export and import of live fish.

$$Z_t = (E_t - I_t) / (E_t + I_t) \dots\dots\dots(2)$$

where Z_t is the normalised trade balance at time t ; E_t is the live fish export (quantity or value) and I_t is live fish import (quantity or value) at time t .

The propositional contribution of import quantity and value of each sub-class of HS-0301 to the total live fish import quantity and value was computed using Equations (3) and (4), respectively to understand the commodity-wise and importing country-wise composition.

$$PoQ_{ij} = Q_{ij} / TLF_i \dots\dots\dots(3)$$

$$PoV_{ij} = V_{ij} / TLFV_i \dots\dots\dots(4)$$

where PoQ_{ij} and PoV_{ij} are the proposition of quantity and value of j^{th} sub-commodity imported in the i^{th} year; Q_{ij} and V_{ij} are the quantity and value of live fish under each sub-head imported in the i^{th} year; TLF_i is the total quantity of live fish imported in the i^{th} year and $TLFV_i$ is the total value of live fish imported in the i^{th} year.

Correspondence analysis was performed to quantify the association between year-wise and country-wise live fish import to India under HS-0301 and also to identify the structural changes happening in major fish importing countries over the years (Greenacre, 2007).

Results and discussion

The import of live fish to India under the head HS-0301 has grown exponentially during the period 2000-2019. India imported just 1.32 t of live fish in the year 2000 worth US \$ 0.018 million, but the volume of live fish import trade had grown to 653.27 t worth US\$ 3.21 million in 2019. Exponential model was fitted to the live fish import data under the head HS-0301 with an R^2 value of 0.83 and RMSE of 170.28. The estimated growth rate was found to be 0.342 with a standard error of 0.09. The exponential growth phase of live fish import to India started since 2015, till then India was importing less than 100 t. During the subsequent years, India imported 114.25, 708.34, 1211.79 and 653.27 t of live fish worth US\$ 0.43, 2.07, 3.26 and 3.21 million in 2016, 2017, 2018 and 2019, respectively. The actual, predicted value of

Table 1. Sub-classes of HS-0301 with description

HS codes	Item and description
0301	Fish; live
030110	Fish; live, ornamental
030111	Fish; live, ornamental, freshwater
030119	Fish; live, ornamental, other than freshwater
030191	Fish; live, trout (<i>Salmo trutta</i> , <i>Salmo gairdneri</i> , <i>Salmo clarki</i> , <i>Salmo aguabonita</i> , <i>Salmo gilae</i>)
030193	Fish; live, carp (<i>Cyprinus</i> spp., <i>Carassius</i> spp., <i>Ctenopharyngodon idella</i> , <i>Hypophthalmichthys</i> spp., <i>Cirrhinus</i> spp., <i>Mylopharyngodon piceus</i> , <i>Catla catla</i> , <i>Labeo</i> spp., <i>Osteochilus hasselti</i> , <i>Leptobarbus hoeveni</i> , <i>Megalobrama</i> spp.)
030199	Fish; live, n.e.s. in heading no. 0301

*n.e.s: Not elsewhere specified

trade data in terms of quantity of live fish imported along with import value is given in Fig. 1. Noticeably, India had not imported any form of live fish under the head HS-0301 in 2002 and 2006. India had imported live fish only from Singapore in 2004. The normalised trade balance index was calculated for live fish trade in India is depicted in Fig. 2. The normalised trade balance was in the range of 0.78 to 0.99 for trade quantity and 0.87-0.99 for trade value. It is evident from Fig. 2 that India's export dominance in live fish has come down since 2016, as India's imports started to grow exponentially. This indicates that the internal live fish trade in India depends on import of live fish to India under the head HS-0301 since 2016.

The major countries exporting live fish to India were Bangladesh, Thailand, Indonesia, Singapore, Malaysia, Srilanka, Japan and USA. All these countries together contributed 86.31, 89.73 and 98.13% of total live fish import to India worth 85.30, 90.42 and 97.75% of total live fish import value in 2010, 2015 and 2019, respectively. Bangladesh ranked first, which was exporting live fish to India since last few years. India imported 468, 978 and 433 t of live fish from Bangladesh, which accounted 66.06, 80.71 and 66.28% of total live fish imported in 2017, 2018 and

2019, respectively. The second placed Thailand imported 110.74, 105.31 and 118.16 t of live fish, which accounted 15.63, 8.69 and 18.09% of total live fish imported during this period. Bangladesh and Thailand earned US \$ 1.21, 2.34 and 0.94 million and US \$ 0.41, 0.38 and 1.44 million through foreign exchange from India in 2017, 2018 and 2019, respectively. The quantity-wise ranking of major export countries and percentage contribution of live fish import is given in Table 2. The value-wise contribution of Bangladesh (29.29%) has come second behind Thailand (44.91%) in spite of 66.28% of total live fish import in 2019. Similarly, Dey (2016) reported that Thailand is one of the major suppliers in terms of quantity and value of marine and freshwater ornamental fish. The value-wise contribution of countries importing live fish to India is given in Fig. 3. The quantity and value-wise contribution of Singapore, Japan and USA have come down drastically over the years. In 2004, Singapore accounted for 100% of quantity and value. The value-wise contribution of Thailand has increased and reached first position in 2019. The biplot of correspondence analysis of live fish import data of major countries is given in Fig. 4. Two components explained 85.32% of total variability in the live fish import data. It can be understood from the figure that Bangladesh contributed significantly to the live fish import to India in the initial years 2005 and 2007; later years in 2017, 2018 and 2019 as it did not vary away from the origin of the biplot. The contributions of Singapore, Thailand, Indonesia and Malaysia have varied as evident from the figure.

India imports live fish mainly under six sub classifications as indicated in Table 1 (*viz:* 030110, 030111, 030119, 030191, 030193 and 030199 under HS code 0301). The quantity and value-wise import of live fish to India under different sub-classes are given in Fig. 5a and b, respectively. India imported substantial quantity of ornamental fish during the period 2000-2019. The import of live fish in terms of quantity and value under the heads HS-030199, HS-030111 and HS-030119 increased exponentially since 2016, but compared to other heads, the import of live fish not mentioned in any

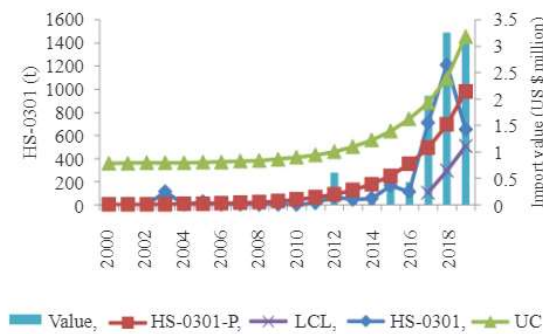


Fig. 1. Actual and predicted values of total live fish import trade to India. UCL: Upper control limits; LCL: Lower control limits



Fig. 2. Normalised trade balance of live fish in India

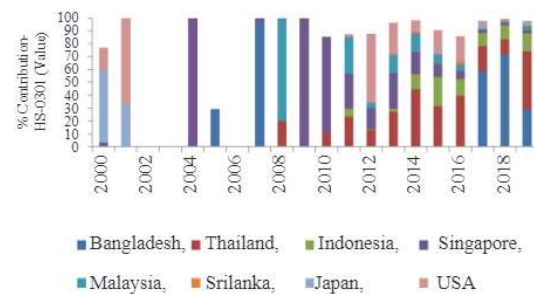


Fig. 3. The value-wise contribution of countries exporting live fish to India

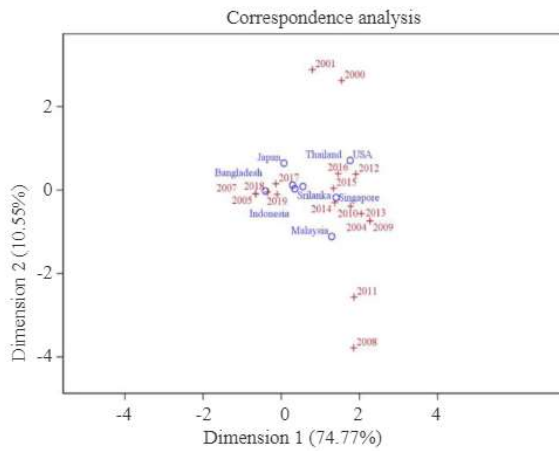


Fig. 4. Biplot of market diversification of live fish import to India

Table 2. Ranking of major countries exporting live fish to India

HS - 0301	Year			
	2005	2010	2015	2019
Countries				
Bangladesh	1 (38.15%)	(0.00%)	8 (0.00%)	1 (66.28%)
Thailand	(0.00%)	2 (13.85%)	1 (33.81%)	2 (18.09%)
Indonesia	(0.00%)	(0.00%)	2 (20.89%)	3 (6.53%)
Singapore	(0.00%)	1 (72.45%)	3 (16.19%)	4 (3.31%)
Malaysia	(0.00%)	(0.00%)	5 (8.08%)	5 (2.71%)
Sri Lanka	(0.00%)	(0.00%)	7 (0.48%)	6 (0.67%)
Japan	(0.00%)	(0.00%)	6 (1.51%)	7 (0.53%)
USA	(0.00%)	(0.00%)	4 (8.75%)	8 (0.00%)

other heads (HS-030199) has grown many folds. The proportional contribution of trade quantity and value of each sub-class to the total live fish import to India is shown in Fig. 6a and b, respectively. The major contribution to the total live fish import to India was accounted from the

head HS-030199 in terms of import quantity and value, followed by HS-030119 and HS-030111. The sub-class HS-030199 accounted almost two third of total live fish import to India since 2016. Details of live fish import to India under different sub-classes of HS-0301 is discussed in the subsequent sections.

HS Code-030110: India had imported 1.26-17.36 t ornamental fishes worth US \$ 0.017-0.051 million during the period 2000-2012 under the head HS-030110, but since then stopped importing ornamental fish under this sub-class. The major countries importing live fish to India under the head HS-030110 were Singapore and Thailand.

HS Code-030111: Since 2013, India started to import freshwater ornamental fish under the sub-class HS-030111. India imported 22.51 t of freshwater ornamental fish in 2013 worth US \$ 0.039 million; which increased to 40.41 t worth US \$ 0.29 million in 2019. Except for a slump in the import during 2016 (71.58 and -59.19% for quantity and value, respectively compared to the previous year), the import generally remained positive during the period. Thailand was the major country importing freshwater ornamental fish to India under the sub-class HS-030111 (both in terms of import quantity and value) constituting nearly 50%. This was followed by Singapore and Malaysia (Fig. 7a and b). Dey (2016) reported that Thailand is one of the major suppliers of marine and freshwater ornamental fish. Similar results were reported by Sinsari and Priono (2019).

HS Code-030119: India was importing marine ornamental fish since 2013 under the head HS-030119. India imported 12.45 t of live fish under this head in 2014 worth US \$ 0.042 million with a growth rate of 138.60 and 5.87%, respectively for import quantity and value. The year on year growth rate increased to 211.18 and 588.64% respectively

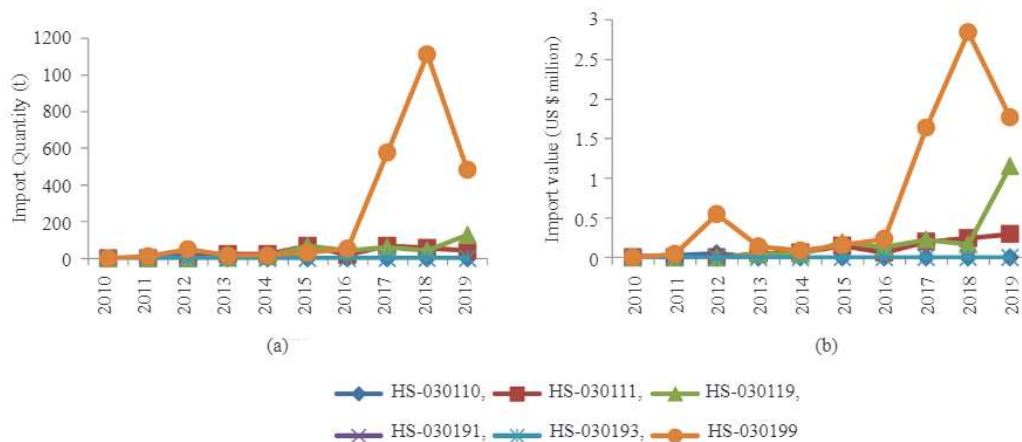


Fig. 5. Import of live fish under different sub-classes of HS-0301. (a) Quantity and (b) Value

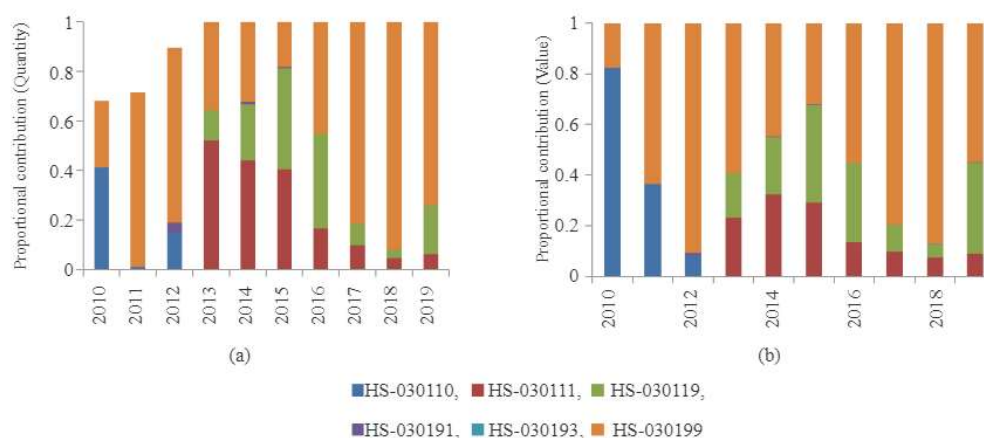


Fig. 6. Proportional contribution of different sub-classes to total live fish import in India. (a) Quantity and (b) Value

for quantity and value in 2019. But, the import has shown some elements of instability, as negative growth rates for quantity and value were reported in the years 2016 and 2018 compared to their respective previous years. The major countries exporting marine ornamental fish to India were Thailand, Indonesia, Singapore, Malaysia and Sri Lanka (Dey, 2016). All these countries together contributed 70 to 98% of total marine ornamental fish import to India during the period 2013-2019. To substantiate this result, Biondo and Burki (2020) also reported that the export value of fresh and marine water fish from Asian region touched US\$ 250 million business in 2014. The quantity and value-wise contribution of major countries are depicted in Fig. 7c and d, respectively. Thailand and Indonesia earned almost 80% of the total foreign exchange spent on importing marine ornamental fish to India in 2019 under the head HS-0301.

HS-030191 and 030193: India imported 2.69, 0.57, 0.83 and 0.04 t of live trout worth US\$ 0.005, 0.0005, 0.002 and 0.004 million in 2012, 2014, 2015 and 2019, respectively under the head HS-030191. This accounted for less than 0.05% of total live fish import under the head HS-0301. The major species of imported live trout's were *Salmo trutta*, *Salmo gairdneri*, *Salmo clarki*, *Salmo aguabonita* and *Salmo gilae*. The major import sources were Thailand, Singapore, Malaysia and Denmark during this period. India imported only a meagre quantity of 0.60 t of live carp worth US\$ 0.003 million from Indonesia in 2018 under the head HS-030193.

HS-030199: The sub-class HS-030199 with a description: fish; live, not elsewhere specified (n.es.) under HS-0301 contributed significantly to the total live fish import to India since 2016 accounting for nearly 45 to 91% of import quantity during 2016-2019. The live fish import not mentioned in the other sub-headings given in Table 1,

is accounted under this sub-class. The import of live fish accounted only less than 50 t up to 2015 except in 2003 in the sub-class HS-030199. Since then, the import quantities of live fish registered under this sub-class were 51.73, 577.66, 1113.28 and 483.68 t worth US\$ 0.24, 1.64, 2.84 and 1.76 million, respectively in 2016, 2017, 2018 and 2019. This formed 45.27, 81.55, 91.86 and 74.04% of total live fish import quantity and 55.19, 79.44, 87.24 and 54.97% of total live fish import value in respective years. The increase in live fish import to India under this category attained exponential growth among the total live fish import to India. Thailand was the major importing country under this category, but of late by 2017 Bangladesh reached the first position in terms of import quantity and value. India imported 468, 978 and 402 t of live fish from Bangladesh worth US\$ 1.22, 2.34 and 0.88 million under this category in 2017, 2018 and 2019, respectively. This accounted 81.02, 87.84 and 83.11% of total import quantity and 0.74, 82.42 and 49.51% of total import value under this category. This could be due to import of live hilsa (*Tenualosa ilisha*) and other freshwater fishes not mentioned in other sub-heads from Bangladesh. Mostafa *et al.* (2020) reported that Bangladesh has exported 12454 t of live fish worth US\$ 22.86 million in 2016. Interestingly, India had imported only 42.73 t of live fish worth US\$ 0.59 million from Thailand under this head in 2019, which accounted only 8.83% of quantity but earned 33.74% of import value. The other major importing countries were Indonesia, Malaysia and Singapore. The proportional contribution of major countries to the import quantity and value under the head HS-030199 is shown in Fig. 7e and f, respectively.

HS code-03061690: Based on the available data, the commercial import of live broodstock of *Penaeus vannamei* to India was found to increase linearly over the period. India had imported 260 t of broodstock in 2013 worth

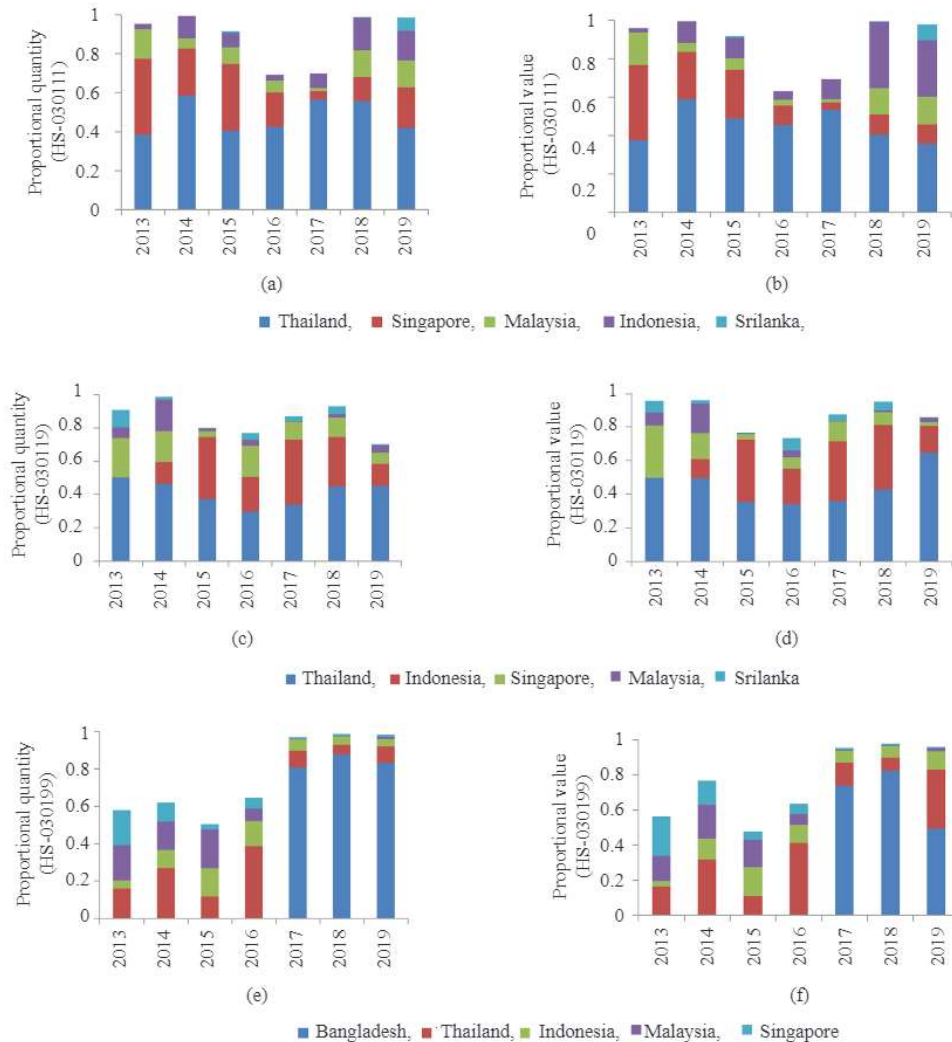


Fig. 7. Market channelisation of live fish import to India. (a) Quantity under HS Code-030111; (b) Value under HS Code-030111; (c) Quantity under HS Code-030119; (d) Value under HS Code-030119; (e) Quantity under HS Code-030199; (f) Value under HS Code-030199

US \$5.97 million, which increased to 731 t worth US\$16.56 million in 2019 at a rate of 85 t per year. The import quantity and value of live broodstock of *P. vannamei* is given in Fig. 8.

The import of broodstock of *P. vannamei* has significantly contributed towards increased area under culture (AUC) of this species and its production. *P. vannamei* culture was just 283 ha in 2010, which increased manifold to reach 100206 ha in 2019. The production also increased from 1731 t to 711674 t during this period. This has significantly contributed to the export of shrimp products from India to global markets, and thus towards the country's foreign exchange earnings.

Biosafety concerns

The import of live fish to India under the head HS-0301 has shown an exponential increase during the decade since 2010. One of the major components of the live fish import trade to India are marine and freshwater ornamental fish, whose trade increased from US \$ 0.017 million in 2000 to US \$ 3.21 million in 2019, mainly from Thailand, Indonesia, Malaysia, Singapore and Sri Lanka. The demand for alien fish species is growing in India, for ornamental purpose as well as for aquaculture. There are reports indicating presence of exotic ornamental fishes in many inland aquatic systems in India including in the biodiversity-sensitive areas (Sandilyan, 2016). The risks



Fig. 8. Import statistics of live brood-stock of *P. vannamei* to India

include the potential of this alien fishes becoming invasive species, as is reported in several countries affecting the health of the aquatic ecosystems (Garcia-Berthou, 2007; Singh and Lakra, 2011). Some of the areas of concern in the supply chain of ornamental fish trade pointed out by Dey (2016) were: traceability, disease and introduction of exotic species. India's response towards these issues has been largely by invoking licensing requirement in tune with SPS conditions and establishing quarantine facilities. Further, a pre-quarantine certificate issued by the exporting countries is also insisted upon. India's strict biosafety concerns has its own trade-off, but the potential risk avoided is considered to outweigh the loss, as India is rich with aquatic biodiversity and a large population depends on aquatic systems for their food and livelihood security.

Even though the alien species possess some favourable culture characteristics, they also poses the risk of reducing the availability of local species. Several studies have disclosed the occurrence of exotic ornamental fishes in many inland aquatic systems, including the biodiversity sensitive areas of India (Sandilyan, 2016). Further, they also have the potential to become invasive species. Such reports have come from several countries (Garcia-Berthou, 2007; De Silva *et al.*, 2009). They establish in natural water bodies, turn to be invasive, adversely affecting fish biodiversity and aquatic ecosystems. This has necessitated formulation of policies, sensitive to the adverse environmental, socio-economic and biodiversity impacts. However, there is lack of detailed information regarding the marine ornamental fish trade. This necessitates developing a comprehensive monitoring system which could generate information on details of the live fish transported (Biondo and Burki, 2020). The actions were mainly in the form of establishing quarantine and health certification programmes for the import of fish. The live fish and aquarium business is a thriving business in India, growing at a fast rate. Therefore, considering the economic potential of live fish import in boosting

domestic fish production, the strategy is to carefully evaluate the economic trade off of conservation approach and fish import and put in place a foolproof system to develop stocks of imported fish in India itself. With this background, the Govt. of India has allowed culture of tilapia (*O. niloticus*) and *P. vannamei* as well as some aquarium fishes following strict guidelines. One key issue is the relative lack of quarantine facilities for fish import, which can be developed as public, private or public-private partnership models. Further, there is a need to develop comprehensive policies and acts to import fish to India for commercial and research purpose. Some of the developed countries in Europe have developed comprehensive policies in this regard. For instance, U.K. in 1975 itself has rendered, transport of native and non-native fishes within the political boundaries without proper procedure as illegal and the suit was followed by EU (Sandilyan, 2016).

The live fish import trade in India under the head HS-0301 is not a free trade. There are some guidelines for import of fish to India, mainly in terms of strict sanitary and phyto-sanitary measures. The persons importing fish to India should have proper license (or through a licensed agency) and facilities to keep the fish under quarantine condition. The fish imported should not fall under any endangered species category. The National Committee on Introduction of Aquatic Species is empowered to screen the exotic aquatic species before they are introduced to India. The Govt. of India has brought out new guidelines for importing live fish to India (http://dahd.nic.in/sites/default/files/Protocol%20for%20import%20of%20ornamental_fish%202016%20_0.pdf). The import also requires a pre-quarantine certificate issued by the exporting countries, which is to be followed by post-quarantine follow up. Despite these measures, illegal import of live fish occurs in many instances. Occasional floods have revealed the presence of some of the non-approved alien species in India, brought through illegal means. The import of live fish including ornamental and other forms of live fish is a boon to the Indian economy, but these have to be screened and empowered for compliance through properly laid down regulatory measures in order to protect our aquatic ecosystems.

The import of live fish to India witnessed an exponential growth at a rate of 0.342 during 2000-2019 period. This growth in live fish import trade was substantiated with the decreasing values of normalised trade balance in the range of 0.77-0.99, which indicates that there is an increasing demand for live ornamental and other types of live fishes in the Indian market. The countries like Bangladesh, Thailand, Indonesia, Malaysia and Singapore are seeing India as a potential market to export live fish including ornamental fish. Thailand has

pushed other Asian countries behind to become one of the leading suppliers of ornamental fish. Aquarium and live fish market is a thriving business in India and is considered as a key area for doubling farmers' income. Import of fish has the potential to augment this. However, import of alien fish poses serious threats to domestic biodiversity and therefore income, livelihood security and food security in the country. Therefore, the economic trade off of income and the risk of invasion of alien species are to be carefully evaluated on a case by case basis. This is to be supported by legal and institutional framework. Infrastructure in terms of establishing quarantine facilities is also critical in furthering the prospect of safe live fish import.

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