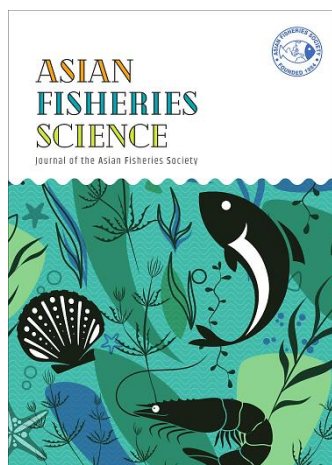




Trends of Aquaculture Production and Trade: Carp, Tilapia, and Shrimp

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Abstract

Carp, tilapia, and shrimp are the most commonly cultured aquatic animals in meeting domestic and international demand for aquatic animal food and contributing to the local and national economies. These species groups accounted for nearly 50 % of the total production of farmed aquatic animals in 2018. Globally, carp remains the most important group of farmed aquatic animals, both in terms of quantity and total value. Carp are produced traditionally for domestic consumption but play an insignificant role in international trade. Globally, tilapia is one of the most popularly farmed aquatic animals. Production of cultured tilapia increased rapidly between 1998 and 2018, making it the second-most important group of farmed aquatic animals by quantity. Tilapia has become an important internationally traded aquaculture commodity, although the majority of its production is still consumed domestically. Shrimp has a relatively high market value and between 1998 and 2018, the general trend in production of farmed shrimp has been upwards. Unlike carp and tilapia, farmed shrimp are primarily destined for the international markets. Shrimp exports followed a general growth trend between 1997 and 2017. Production of farmed carp and tilapia will continue to grow, largely because of their importance in national food security and nutrition. Increasing incomes and improving living standards are likely to increase the demand for shrimp both domestically and internationally. However, although both production and international trade of shrimp are expected to continue to grow, they may face uncertainties related to limiting factors such as natural resource constraint and climate change.

Keywords: review, quantity, value, export, global, domestic market, prospect

Introduction

Fish and other aquatic animals are important sources of animal protein and other important nutrients in peoples' diets. Between 1961 and 2016, the average annual increase in global food fish consumption (3.2 %) outpaced population growth (1.6 %) (FAO, 2018). As a result, food fish consumption increased to 20.5 kg.capita⁻¹ in 2017 from 9 kg.capita⁻¹ in 1961. This increase in per capita fish consumption has been largely attributed to the rapid development of global aquaculture since the 1980s. Aquaculture currently supplies 50 % of food fish for direct human consumption globally.

Aquaculture is a complex food production sector that

includes a great diversity of aquatic animals and plants. Different groups of farmed aquatic animals and plants play different roles in food and nutritional security. Meanwhile, some groups of farmed aquatic animals and plants are also important commodities in international trade. This paper focuses on the three most important groups of farmed aquatic animals in terms of global production quantity and value, namely: carp, referring species in the Family Cyprinidae, such as grass carp (*Ctenopharyngodon idella* (Valenciennes, 1844)), silver carp (*Hypophthalmichthys molitrix* (Valenciennes, 1844)), common carp (*Cyprinus carpio* Linnaeus, 1758), bighead carp (*Hypophthalmichthys nobilis* (Richardson, 1845)), catla (*Gibeleon catla* (Hamilton, 1822)), *Carassius* spp. and rohu labeo (*Labeo rohita* (Hamilton, 1822)); tilapia, referring species in the

Family Cichlidae such as Nile tilapia (*Oreochromis niloticus* (Linnaeus, 1758)), blue tilapia (*Oreochromis aureus* (Steindachner, 1864)) and Mozambique tilapia (*Oreochromis mossambicus* (Peters, 1852)); and shrimp, referring the species included in the International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP) “shrimp, prawn” group (which excludes freshwater prawn), such as whiteleg shrimp (*Penaeus vannamei* Boone, 1931), giant tiger prawn (*Penaeus monodon* Fabricius, 1798), kuruma prawn (*Penaeus japonicus* Bate, 1888), fleshy prawn (*Penaeus chinensis* (Osbeck, 1765)) and banana prawn (*Penaeus indicus* De Man, 1888). These three species groups play different roles in ensuring national food and nutrition security, meeting international market demand, and contributing to rural livelihoods. Understanding the trends in aquaculture production and international trade of carp, tilapia, and shrimp can help in shaping the future development of the subsectors and creating the strategies needed to support their development. All the production data used in this paper is from or generated from “Fishery and Aquaculture Statistics. Global aquaculture production 1950–2018 (FishstatJ). In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 2020”. All the trade data used in this paper is from or generated from “Fishery and Aquaculture Statistics. Global Fisheries commodities production and trade 1976–2017 (FishstatJ). In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 2019”.

Global Production of Farmed Carp

Carp are fish species in the Family Cyprinidae, a large family that includes cultured species such as common carp, Chinese carp, Indian major carp and *Carassius* spp. that have the longest history of aquatic farming in the world. Carp farming practices were recorded as early as 2,500 years ago. Carp is also one of the most commonly cultured groups of aquatic animals worldwide. According to Food and Agriculture Organization of the United Nations (FAO) Fisheries and Aquaculture Statistics, 123 countries or regions reported cultured carp production to FAO in 2018. The global farmed carp production reached 28.9 million tonnes in 2018, which is historically high.

Production trend of farmed carp

Carp is the most important group of aquatic animals species being cultured around the world in terms of both production quantity and value. Carp accounted for 25.2 % of global aquaculture production in 2018, which is a significant decline from the highest production of 35.1 % in 1997. Carp accounted for 35.2 % of global cultured aquatic animal production in 2018, which is significantly lower than the highest production, which was 45.8 % in 1997. Carp also accounted for 53.2 % of global cultured finfish production in 2018, which is a drastic decline from the 71.1 % contribution seen in 1996.

The total value of farmed carp reached 61.6 billion US dollars in 2018, which accounted for 23.4 % of total global aquaculture output value for that year. The share of total aquaculture output value contributed by farmed carp has significantly declined from the peak of 29.9 % achieved in 1985. Since 1950, when Member Countries first began reporting relevant aquaculture production statistics to FAO, the lowest share contributed by farmed carp to the total global aquaculture output value was 21.4 % in 2006. This decreased contribution to the global aquaculture output value is largely due to the reduced share of carp in the global aquaculture production.

During the three decades from 1989 to 2018, farmed carp production had an average annual growth of 6.0 %, ranging between 1.3 to 18.7 % throughout the period (Fig. 1). The fastest growth of production took place from 1992 to 1996, averaging 16.3 % annually. Since 1997, the annual production growth has dropped to 1.3 to 6.7 %, except for 8.0 % in 2004.

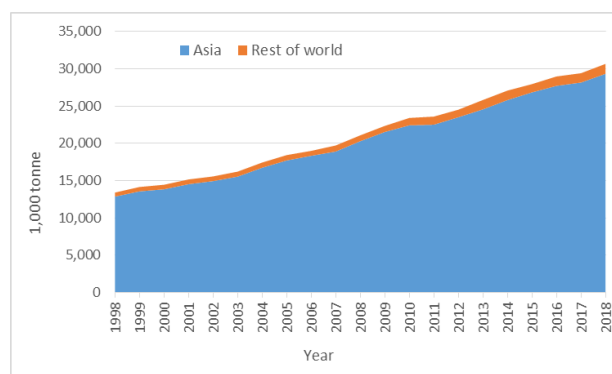


Fig. 1. Production of cultured carp in the world.

Global producers of farmed carp

Although carp are globally cultured, their production has been dominated by Asia (Table 1). The top-seven producers of farmed carp are all Asian countries, which together contributed 96.3 % of the world production in 2018. China has always been the major producer of farmed carp. However, its share in the world production has declined to 68.1 % in 2018 from 78.9 % in 1998, which can be attributed to both faster growth in aquaculture production of non-carp species in China and the reduced share of China in the world aquaculture production.

Globally, 51 species or species groups of carp are included in the FAO statistics for farmed carp production reported by the member nations. There were 29 farmed carp species with an individual production of over 100 tonnes in 2018. In 2018, 12 carp species contributed individually to over 1 % of the world production of farmed carp (Table 2). In 2007, grass carp surpassed silver carp to become the most important carp species. However, its share in the world production of farmed carp declined from 21.1 %

Table 1. Major producers of cultured carp in the world (individual production above 50,000 tonnes in 2018).

Country	Production (1,000 tonne)		% in global production	
	1998	2018	1998	2018
China	10,074	19,668	78.86	68.14
India	1,551	4,646	12.15	16.10
Bangladesh	402	1,175	3.15	4.07
Myanmar	80	999	0.62	3.46
Viet Nam	-	550	-	1.91
Indonesia	144	606	1.13	2.10
Pakistan	17	156	0.14	0.54
Russia	55	122	0.43	0.42
Iran	27	187	0.21	0.65
Egypt	51	181	0.40	0.63

Table 2. Global production of 12 major cultured carp species.

Species	Production (1,000 tonne)		% of total carp production	
	1998	2018	1998	2018
Grass carp (<i>Ctenopharyngodon idella</i> (Valenciennes, 1844))	2,698	5,704	21.12	19.76
Silver carp (<i>Hypophthalmichthys molitrix</i> (Valenciennes, 1844))	3,007	4,789	23.54	16.59
Common carp (<i>Cyprinus carpio</i> Linnaeus, 1758)	2,185	4,190	17.10	14.51
Bighead carp (<i>Hypophthalmichthys nobilis</i> (Richardson, 1845))	1,424	3,144	11.15	10.89
Catla (<i>Gibeleon catla</i> (Hamilton, 1822))	555	3,041	4.35	10.54
<i>Carassius</i> spp.	926	2,772	7.25	9.60
Rohu labeo (<i>Labeo rohita</i> (Hamilton, 1822))	660	2,017	5.17	6.99
Wuchang bream (<i>Megalobrama amblycephala</i> Yi, 1955)	403	784	3.16	2.71
Black carp (<i>Mylopharyngodon piceus</i> (Richardson, 1846))	138	692	1.08	2.40
Cyprinids nei* (Cyprinidae)	43	654	0.33	2.27
Mrigal carp (<i>Cirrhinus cirrhosus</i> (Bloch, 1795))	500	501	3.91	1.74
Silver barb (<i>Barbonymus schwanenfeldii</i> (Bleeker, 1854))	69	380	0.54	1.32

*not elsewhere included.

in 1998 to 19.8 % in 2018. The share of silver carp, the former top farmed carp species in the world by production, declined from 23.5 % in 1998 to 16.6 % in 2018. The production of farmed catla increased nearly five fold between 1998 and 2018, its share in the world production of farmed carp increasing to 10.5 % in 2018 from 4.3 % in 1998. The share of *Carassius* spp. and rohu labeo in the world production of farmed carp increased to 9.6 % and 7.0 % in 2018 from 7.3 % and 5.2 % in 1998, respectively. The share of mrigal carp (*Cirrhinus cirrhosus* (Bloch, 1795)) declined from 3.9 % in 1998 to 1.7 % in 2018.

Global Production of Farmed Tilapia

Production trend of farmed tilapia

Tilapia surpassed salmonids to become the second-most important farmed finfish group by quantity in 2005, when its farmed production first reached 2 million tonnes. By 2018, the world production of farmed tilapia reached 6.03 million tonnes, which further consolidated the position of tilapia as the second-most important farmed finfish species group. It also became the second-most important species

group of cultured aquatic animals in 2014 in terms of quantity, when its production first exceeded 5 million tonnes.

Farmed tilapia accounted for 5.27 % of global aquaculture production in 2018, which was more than double the 2.38 % in 1998. The share of farmed tilapia in the world production of farmed aquatic animals reached 7.34 % in 2018, an increase of 133 % over 1998. In 2018, tilapia increased its share in the global production of farmed finfish to 11.11 % from 4.85 % in 1998.

In 2018, the total estimated value of farmed tilapia reached 11.2 billion US dollars, accounting for 4.5 % of the total value of all cultured aquatic animals, a significant increase from 2.8 % in 1998, but lower than the peak of 5.2 % in 2012.

The tilapia-farming sector has achieved much faster growth than the overall aquaculture industry and most farmed aquatic species groups in the past two decades (Fig. 2). The average production growth of farmed tilapia reached 10.1 % between 1999 and 2018. The most rapid production growth of farmed tilapia took place from 1999 to 2013, with an average annual production growth rate of 11.8 %. From 2014 to 2018, the growth of farmed tilapia production slowed down to 5 % per year on average, fluctuating between 1.6 and 8.9 %, with the lowest growth of 1.6 % occurring in 2018.

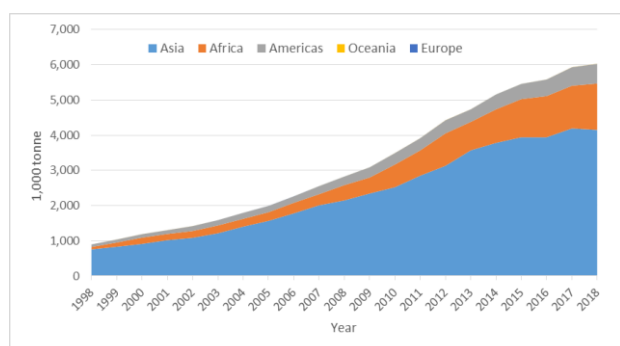


Fig. 2. Production of cultured tilapia in the world.

Producers of farmed tilapia in the world

Tilapia is currently the most popularly cultured aquatic animal group in the world, with 145 countries or regions reporting cultured tilapia production to FAO in 2018. Although tilapia originated in Africa, Asia has dominated its production ever since the fish was introduced to aquaculture. Asia produced 4.2 million tonnes of farmed tilapia in 2018, which accounted for 68.8 % of the world total. However, Asia's share of in the world production has declined significantly compared with 84.4 % in 1998. In contrast, Africa, the original source of tilapia, has successfully increased

its share from 7.5 % in 1998 to 21.8 % in 2018. The share of the Americas slightly increased to 9.3 % in 2018 from 8.1 % in 1998.

China remained the largest producer of farmed tilapia in 2018, with a production of 1.62 million tonnes (Table 3). However, its share in the world production declined from 52.3 % in 1998 to 26.9 % in 2018. Meanwhile, in 2013, Indonesia surpassed Egypt to become the world's second-largest producer of farmed tilapia. It produced 1.22 million tonnes of farmed tilapia in 2018, which accounted for 20.3 % of the world total. In 2018, Egypt was the only African country among the top-ten producers of farmed tilapia, contributing 17.4 % of the world total. Thailand and the Philippines used to be among the top-four producers of farmed tilapia, however, their shares in the world production of farmed tilapia declined to 3.5 % and 4.6 %, respectively in 2018.

Cultured tilapia production by species

Globally, 23 species and species groups in the family Cichlidae were included in FAO aquaculture production statistics by 2018. Among these, Nile tilapia has dominated global farmed tilapia production (Table 4). World production of farmed Nile tilapia reached 4.53 million tonnes in 2018, which accounted for 75 % of the total farmed tilapia production. However, the share of Nile tilapia in total production of farmed tilapia has declined significantly from 83.4 % in 1998. The production of tilapia that is not elsewhere included accounted for 17.1 % in the total farmed tilapia production, which suggests a significant proportion of farmed tilapia production could be reported down to species level. In 2018, production of the hybrid of blue tilapia and Nile tilapia reached 0.41 million tonnes and accounted for 6.7 % of total farmed tilapia production. The production is primarily from China, where technology has been adopted to take advantage of all male offspring (>95 %) from the hybridisation of blue tilapia and Nile tilapia without hormone manipulation. The share of Mozambique tilapia in the total farmed tilapia production significantly declined to less than 1 % in 2018.

Production of Cultured Shrimp

Production trend of farmed shrimp

Shrimp is the most important species group cultured worldwide in terms of international trade. The world production of farmed shrimp reached 6 million tonnes in 2018 (FAO, 2020) which is an historical record. Shrimp is also been the most important species group of farmed crustaceans globally, contributing 64.0 % of the world production of farmed crustaceans in 2018, the lowest since the peak share of 91.9 % in 1992. The share of shrimp in total farmed crustaceans has fluctuated between 64.0 % and 73.8 % from 1999 to 2018. The share of farmed shrimp in the world

Table 3. Major producers of cultured tilapia in the world (individual production above 50,000 tonnes in 2018).

Country/Region	Production (1,000 tonne)		% in global production	
	1998	2018	1998	2018
China	471.8	1,624.5	52.59	26.93
Indonesia	65.9	1,222.7	7.35	20.27
Egypt	52.8	1,051.4	5.88	17.43
Bangladesh	-	344.8	-	5.72
Brazil	24.1	317.1	2.68	5.26
Philippines	72.0	277.0	8.03	4.59
Viet Nam	-	260.0	-	4.31
Thailand	73.8	211.4	8.23	3.51
Colombia	17.7	77.9	1.97	1.29
Ghana	1.4	70.6	0.15	1.17
Uganda	0.2	70.1	0.02	1.16
Taiwan POC	36.1	62.6	4.03	1.04
Mexico	5.4	52.7	0.60	0.87

Table 4. Global production of ten major farmed tilapia species in 2018 (individual farmed production above 1,000 tonnes).

Species	Production (tonne)		% of total tilapia production	
	1998	2018	1998	2018
Nile tilapia (<i>Oreochromis niloticus</i> (Linnaeus, 1758))	748,040	4,525,431	83.38	75.03
Tilapias nei (Cichilidae)	103,564	1,030,004	11.54	17.08
Blue-Nile tilapia, hybrid	0	406,048	0.00	6.73
Mozambique tilapia (<i>Oreochromis mossambicus</i> (Peters, 1852))	40,652	53,754	4.53	0.89
Shire tilapia (<i>Oreochromis shiranus</i> Boulanger, 1897)	0	5,036	0.00	0.08
Blue tilapia (<i>Oreochromis aureus</i> (Steindachner, 1864))	844	3,182	0.09	0.05
Three spotted tilapia (<i>Oreochromis andersonii</i> (Castelnau, 1861))	2,689	2,147	0.30	0.04
Redbreast tilapia (<i>Coptodon rendalli</i> (Boulanger, 1897))	839	1,903	0.09	0.03
Longfin tilapia (<i>Oreochromis macrochir</i> (Boulanger, 1912))	207	1,800	0.02	0.03
Tanganyika tilapia (<i>Oreochromis tanganicae</i> (Günther, 1894))	0	1,690	0.00	0.03

aquaculture production is rather small, only 5.2 % in 2018. However, the share has significantly increased since 1998, when it was only 2.6 %, with the most rapid increase (from 3.0 % to 5.0 %) between 2002 and 2006.

In 2018, the total value of farmed shrimp reached a historical high of 38.4 billion US dollars, contributing 14.6 % to the world aquaculture output value. The share of shrimp in the world aquaculture value in 2018 is the second highest between 1999 and 2018, just next to the share of 15.2 % in 2006. The share of farmed shrimp in world aquaculture by value is nearly three times the share by quantity. The percentage share fluctuated between 12.6 % and 15.2 % from 1999 to 2018. In 2018, shrimp accounted for 7.3 % of the

total production of farmed aquatic animals, more than double the 3.5 % contributed in 1998.

During the period 1998 to 2018, farmed shrimp production maintained higher annual growth than that of global aquaculture, with an average annual growth of 9.7 % in quantity (Fig. 3) vs an average annual growth in total global aquaculture production of only 5.7 % during the same period. The most rapid production growth of farmed shrimp took place during 2001–2006 when the average annual growth in production was 19.0 %. However, the production growth of farmed shrimp dropped to a moderate 5.0 % in 2018, which is still significantly higher than the world aquaculture growth of 2 % in that year.

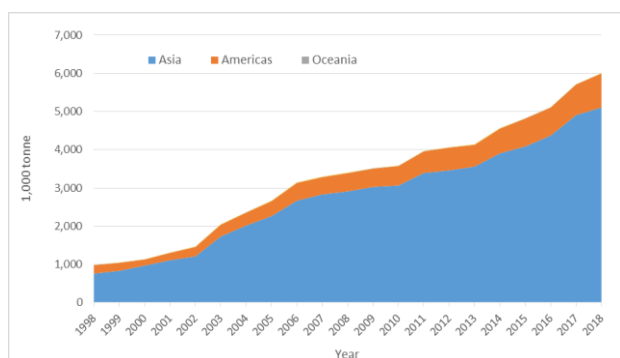


Fig. 3. Production of cultured shrimp in the world.

Producers of farmed shrimp

In 1988, 41 countries and regions reported their production of farmed shrimp to FAO. By 2018, the number of reporting countries and regions had increased to 82, covering all the continents. Farmed shrimp production has always been dominated by Asia and the Americas, which contributed 85.0 % and 14.8 % of the world production in 2018, respectively. However, the share of the Americas in the world production had declined significantly from 22.3 % in 1998. The share of Europe, Africa, and Oceania in the world production of farmed shrimp has always been negligible, dropping to a low of 0.2 % in 2018.

China is currently the largest producer of farmed shrimp (Table 5), and has significantly increased its share in world production from 13.2 % in 1998 to 34.2 % in 2018. The shares of Thailand and Ecuador, the former top-two producers of farmed shrimp in the world, declined from 25.6 % and 14.6 % in 1998 to 6.0 % and 8.5 % in 2018, respectively. Viet Nam, India, and Indonesia have significantly increased their shares in the world production of farmed shrimp from 1998 to 2018.

Species of farmed shrimp and their contribution to the total production

Currently, FAO Fisheries and Aquaculture statistics include 25 species and species groups of farmed shrimp. The giant tiger prawn (*Penaeus monodon*) used to be the dominant species of farmed shrimp (Fig. 4), contributing 51.0 % of the world production in 1998. However, its position as the top farmed shrimp species was taken over by whiteleg shrimp (*P. vannamei*) in 2003, and its contribution to world production had dropped to 12.5 % in 2018. The share of whiteleg shrimp in the world production of farmed shrimp increased from 20.4 % in 1998 to 82.7 % in 2018. The average annual production growth of farmed whiteleg shrimp was 20.6 % during 1999–2018, with the maximum annual growth of 103% in 2003, which led to the historically high production of 5.0 million tonnes in 2018. However, the growth in production has fluctuated throughout the period, largely due to disease problems in farming, such as the outbreaks of acute hepatopancreatic necrosis disease (AHPND) from 2012 to 2014.

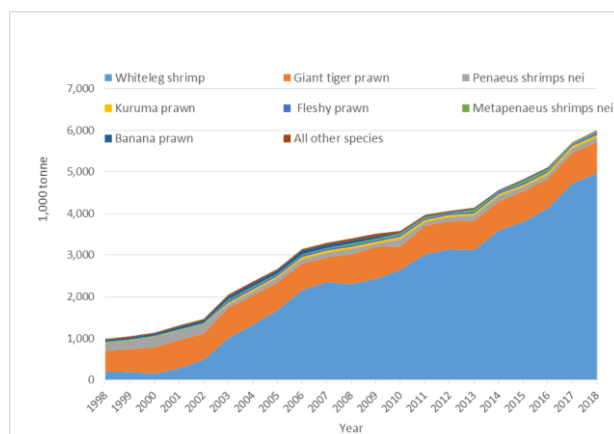


Fig. 4. Global production of major farmed shrimp species.

Table 5. Major producers of cultured shrimp in the world (individual production above 50,000 tonnes in 2018).

Country	Production (1,000 tonne)		% in total production	
	1998	2018	1998	2018
China	130	2,052	13.2	34.2
Indonesia	118	908	12.0	15.1
Viet Nam	52	775	5.3	12.9
India	83	682	8.4	11.4
Ecuador	144	510	14.6	8.5
Thailand	253	363	25.6	6.0
Mexico	24	158	2.4	2.6
Bangladesh	56	71	5.7	1.2
Brazil	7	62	0.7	1.0
Philippines	38	60	3.8	1.0
Saudi Arabia	2	56	0.2	0.9

International Trade of Carp, Tilapia, and Shrimp

Of all animal protein commodities, fish and fish products are among the most traded in terms of value and the most subject to competition from imported products (FAO, 2018). In 2017, the total volume of exported fisheries and aquaculture commodities reached 40.1 million tonnes, which is equivalent to 65 million tonnes in live weight (FAO, 2019a). The total value of exported fisheries and aquaculture commodities reached 156.5 billion US dollars. The total quantity and value of exported fisheries and aquaculture products increased by 44.2 % and 192.9 % respectively between 1997 and 2017 (FAO, 2019a). This implies that the average unit value of exported fisheries and aquaculture commodities is doubled compared with 1997. However, if inflation (around 52 % for the US dollar between 1997–2017) (Inflation Tool, 2020) is taken into consideration, the unit value of exported shrimp in 2017 increased by some 50 % only when compared with the unit value in 1997.

Carp, shrimp, and tilapia are among the most important groups of farmed aquatic animals globally in terms of contribution to people's animal protein supply. They are all traded internationally, although the volumes of international trade for individual groups are not in proportion to their farmed production.

Global trade of carp

Although carp is the most important group of aquatic animals farmed in the world, its contribution to international trade of aquatic products has been very small. The total quantity of exported carp products remained less than 20,000 tonnes until 2011 except for 2006 and 2007, when it was around 0.1 % of the total production (Fig. 5). In 2012, there was a sharp increase in the export of carp products globally, with a 3.7-fold increase in quantity over the previous year. The total annual exported volume of carp in the world has remained above 100,000 tonnes since 2012. However, the share of carp in the global export of aquatic products is still very small, being 0.32 % by quantity and 0.25 % by value in 2017.

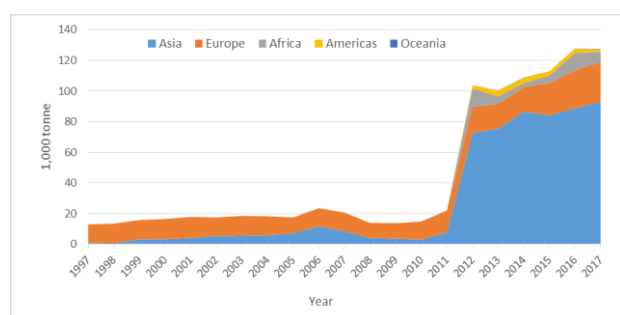


Fig. 5. Global carp exports.

Asia and Europe are the two major exporters of carp globally, having contributed 73.1 % and 20.3 %, respectively, to the world export of carp in 2017. Unlike with the international trade of shrimp and tilapia, the major carp-exporting regions are also the major carp-importing regions. Asia and Europe contributed 68.2 % and 25.7 % of the world carp import, respectively, in 2017, which suggests that the international trade of carp is more within the regions than global.

The major carp-exporting countries in 2017 included China (46,504 tonnes), Thailand (11,972 tonnes), Indonesia (11,817 tonnes), Czech Republic (10,755 tonnes), Turkey (8,034 tonnes), and Myanmar (7,421 tonnes). The largest importer of carp is Hong Kong SAR of China, which imported 41,153 tonnes in 2017. Other major carp importers in 2017 included Iraq (9,178 tonnes), United Arab Emirates (7,117 tonnes), Poland (5,216 tonnes), United Kingdom (4,928 tonnes), Macao SAR of China (4,085 tonnes), and the Kingdom of Saudi Arabia (4,034 tonnes).

Global trade of tilapia

Along with the rapid growth in tilapia farming globally, tilapia has become one of the most important internationally traded freshwater fish and is now the most widely cultured aquatic animal in the world. Although wild catch also contributes significantly to tilapia production, because of the quality requirements for aquatic commodities that are traded on the international markets, tilapia traded internationally originates mainly from aquaculture.

In 2017, the total quantity of exported tilapia products reached 766,438 tonnes in live weight (FAO, 2019a), having increased 22.4 fold between 1997 and 2017. The total value of exported tilapia products reached 1.66 billion US dollars in 2017 (FAO, 2019a), an increase of 39 fold between 1997 and 2017. The average unit price of exported tilapia products was 1.27 USD.kg⁻¹ and 2.17 USD.kg⁻¹ in 1997 and 2017, respectively (FAO, 2019a). The significantly increased unit price (71 % higher) has contributed greatly to the rapid growth in the value of exported tilapia, and also reflects the added value of the products. However, if inflation is taken into consideration, the increase in unit value of exported tilapia becomes far less significant.

The quantity of exported tilapia commodities demonstrates a rapid growth trend from 1997 to 2017 (Fig. 6). Meanwhile, the growth in the quantity of exported tilapia also fluctuated significantly from 1998 to 2017, ranging from -19.5 % (2012) to 72.3 % (2002), with an average annual growth of 16.8 % during this 20-year period (FAO, 2019b). However, the quantity of exported tilapia showed a trend of slight decline in the most recent years (by an average of 0.7 % per year from 2014 to 2017).

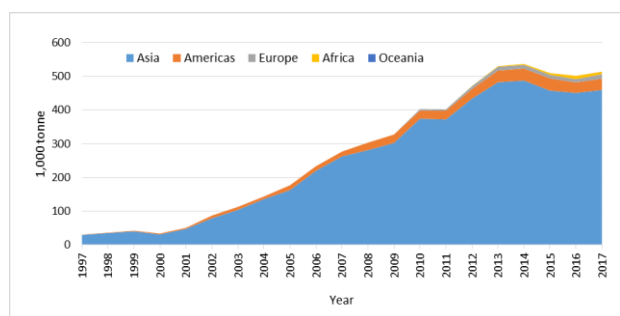


Fig. 6. Global tilapia exports.

In terms of regional contribution to international trade of tilapia, Asia has dominated the export of tilapia products from 1997 to 2017. The share of Asia in the world export of tilapia products was 89.4 % in 2017, which is a slight decline from 97.5 % in 1997. The shares of the Americas, Europe, and Africa increased to 6.5 %, 2.6 %, and 1.4 % in 2017 from 2.5 %, 0 %, and 0 % in 1997, respectively. Although over 70 countries or regions reported the export of tilapia in 2017, China has dominated the global exports since becoming the top exporter of tilapia in 2003. In 2017, China supplied 406,862 tonnes of tilapia products to the global market, which accounted for 79.2 % of the world's tilapia export. In the same year, the individual shares of the other nine top tilapia exporters ranged from 1 % to 4.4 %.

The United States of America is the largest tilapia importer in the world, importing 184,210 tonnes in 2017, which accounted for 38 % of total tilapia imports globally. Mexico is the second-largest tilapia importer, with 13.3 % of the world's tilapia imports in 2017. Côte d'Ivoire is another important importer of tilapia, having imported 35,484 tonnes in 2017, which represented 7.3 % of the world's tilapia imports. Another 13 countries imported over 5,000 tonnes tilapia each in 2017.

International trade of shrimp

Shrimp are heavily traded commodities and represent the second main group of exported species in value terms (FAO, 2018). The international trade data for fisheries and aquaculture commodities are not disaggregated by the source in the FAO Fisheries and Aquaculture Statistics. Although wild shrimp catches contribute large volumes to total supply, most internationally traded shrimp today is farmed (FAO, 2018).

In 2017, the total quantity of exported shrimp products reached 4.4 million tonnes in live weight (FAO, 2019a), an increase of 157.4 % from 1997. The total value of exported shrimp products reached 27.3 billion US dollars in 2017 (FAO, 2019a), an increase of 160.5 % from 1997 value. The average unit price of exported shrimp products was 6.18 USD.kg⁻¹ and 6.26 USD.kg⁻¹ in 1997 and 2017, respectively (FAO, 2019a).

The price of shrimp in the international market has hardly responded to the significant increase in the production cost of farmed shrimp resulting from higher input costs and the stricter requirements for product safety, quality, and farming practices imposed by the importing countries.

The quantity of exported shrimp commodities followed a general growth trend during 1997–2017 (Fig. 7). However, the growth in exported quantity was not steady, ranging from -8.5 % (2012) to 12.3 % (2017), with an average annual growth of 4.8 % during the 20-year period (FAO, 2019b). The sharp decline seen in the export of shrimp in 2012 was due to production losses of farmed shrimp caused by severe outbreaks of AHPND in several major Asian producers.

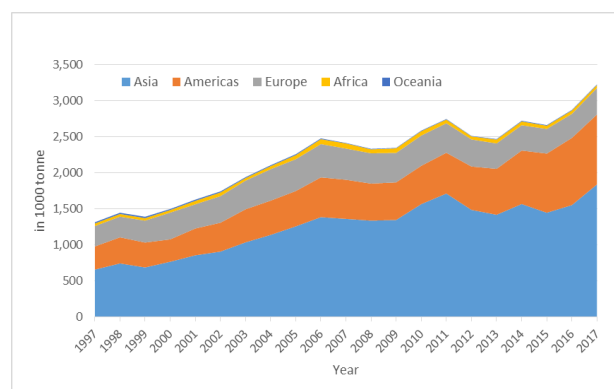


Fig. 7. Global shrimp exports.

In terms of regional contribution to international trade of shrimp, Asia, the Americas, and Europe have remained the major exporters from 1997 to 2017. However, the share of Asia and the Americas in the world shrimp export increased from 50.1 % and 24.5 % in 1997 to 57.0 % and 30.1 % in 2017, respectively, whereas, the share of Europe declined from 21.5 % in 1997 to 11.4 % in 2017. This can be attributed to the increasing share of farmed shrimp in the world shrimp export that has originated from Asia and the Americas.

Thailand was the largest shrimp exporter in 1997, when its share in the global shrimp export was 16.2 % (Table 6). In 2017, its position was replaced by India, and its share in the global shrimp export dropped to 6.7 % and ranked fifth in the world. Viet Nam and Ecuador have significantly increased their shares in the global shrimp export market during the past 20 years. Most of the countries that have significantly increased their share in global shrimp exports have benefited from the growth of farmed shrimp production.

Europe, the Americas, and Asia have remained the major importers of shrimp products from 1997 to 2017. While the share of the Americas in the world shrimp import increased to 30.7 % in 2017 from 26.8 % in

Table 6. Major exporters of shrimp products in the world.

1997			2017		
Country	Quantity(tonne)	% in world total	Country	Quantity(tonne)	% in world total
Thailand	212,399	16.2	India	576,153	17.9
India	111,295	8.5	Ecuador	439,660	13.6
Ecuador	109,521	8.3	Viet Nam	398,450	12.4
Indonesia	80,850	6.2	China	214,954	6.7
Denmark	74,655	5.7	Thailand	214,573	6.7
Viet Nam	67,072	5.1	Argentina	183,292	5.7
China	62,886	4.8	Indonesia	181,842	5.6
Netherlands	44,707	3.4	Denmark	85,208	2.6
Iceland	44,116	3.4	Netherlands	76,553	2.4
Greenland	42,820	3.3	Honduras	66,931	2.1
Mexico	36,848	2.8	Canada	62,200	1.9
Bangladesh	31,514	2.4	Greenland	54,183	1.7

1997, the shares of Europe and Asia declined from 37.4 % and 34.2 % in 1997 to 35.4 % and 30.7 % in 2017, respectively (FAO, 2019b). The decreased share of Asia in the world shrimp import was caused by the significantly reduced shrimp import by Japan, which was not be adequately offset by increased shrimp imports by China and other Asian countries.

The United States of America has remained the world's largest shrimp importer from 1997 to 2017. Its share in the global shrimp import (by volume) increased to 26.2 % in 2017 from 22.9 % in 1997. Japan has remained the second-largest importer; however, its share has declined to 9.2 % in 2017 from 22.8 % in 1997. Spain remained the third-largest importer of shrimp in 2017, with a share of 6.7 %, a slight decline from 6.2 % in 1997. In 2017, China was the fourth largest shrimp importer and exporter in the world, its share having increased to 4.7 % in 2017 from 1.1 % in 1997.

Future Prospects

Aquaculture production of carp, tilapia, and shrimp

Among aquatic species, carp supply the bulk of animal protein and other important nutrients in people's diets in many Asian countries. Despite the slow growth rate and the declining share in the global production of aquatic animals, the position of carp as the staple fish in domestic markets will remain unchanged in most Asian countries due to its low production cost, relatively high productivity, and the simple production technology. More importantly, carp farming has a relatively low carbon footprint because most carp species can utilise natural food to various extent and carp have low animal protein requirements in their commercial feed. Carp are highly tolerant to a wide range of temperature and environmental conditions.

Therefore, promoting carp farming can be an effective strategy for climate-change mitigation and impact adaptation in aquaculture. Besides, carp farming can be well integrated with other agricultural activities such as horticulture, crop farming, and animal husbandry, thereby contributing to more resilient food systems. The potential for further development of carp farming is quite promising. On the other hand, changes in consumer preference could be a limiting factor to the anticipated increase in market demand for carp. Development in carp processing and storage technology and modification of marketing strategies can help the carp-farming sector to better meet the changing requirements of consumers caused by sociodemographic changes, such as smaller family size, urbanisation, and faster life pace.

Tilapia is also a tough fish with a strong ability to adapt to environmental change. As a tropical fish, it can potentially benefit from global warming. Tilapia can be produced with simple technology and at relatively low cost. It can significantly contribute to local food security and nutrition. Tilapia fillet is a product that is well accepted by urban consumers due to its convenience in cooking and boneless nature. Thus further growth in farmed tilapia production can be anticipated.

Shrimp is generally a high-end aquaculture product globally. In general, increasing income and improving living standards can positively influence the demand for shrimp in both international and domestic markets. The governments of many countries are making good efforts to promote farmed shrimp production for the international market. On the other hand, shrimp farming is highly vulnerable to the impacts of climate change and disease. Shrimp farming, particularly when intensive or super intensive, relies on a high level of quality protein in the

feed and a high energy input in the farming operation. Thus it has a relatively high carbon footprint. Major innovations in shrimp feed and health management are essential to the realisation of anticipated growth in farmed shrimp production.

International trade of carp, tilapia, and shrimp

Consumer's preferences cannot be easily changed over a short period. Carp will remain a small player in the international trade of aquatic products. It is hoped that recognising the advantage of carp farming in climate-change mitigation could influence the choice of consumers. Innovation in carp processing and storage may improve the acceptance of consumers in major fish-importing countries. The development of niche markets may significantly increase the international trade of carp, although it may not fundamentally change the role of carp in the international trade of aquatic products.

After a rapid increase in international trade of tilapia for nearly two decades, the world export of tilapia showed a slight decline in 2016 to 2017. This decline may be only a short-term fluctuation instead of an actual trend. Along with the rapid increase in the quantity of internationally traded tilapia, the number of tilapia-importing countries has expanded significantly in the past decade. Added with other factors, such as consumer preference, affordability, and production feature, it is anticipated the global trade of tilapia will further expand.

Being a major internationally traded aquatic commodity, the volume of exported shrimp has increased constantly with some fluctuation during the past two decades. As a highly valued commodity, economic development will positively influence the international trade of shrimp. However, several factors may affect the direction of the shrimp trade. The foreseeable economic downturn caused by the Covid-19 pandemic may have an immediate impact. On the other hand, traditional Western markets for shrimp may have reached saturation after development for decades. Added to the increasingly stringent food safety and social standards for imported shrimp, it is hard to anticipate a significant increase of shrimp exports to the Western markets. On the other hand, economic growth in the developing world may be a good driver for further growth in the international trade of shrimp. For instance, China and Viet Nam significantly increased their shrimp imports from 54,698 and 17,605 tonnes in 2012 to 118,974 and 51,642 tonnes in 2017. This can make people more optimistic about the future of international trade of shrimp.

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