Socio-economic impacts of Coronavirus (COVID-19) outbreak on world shrimp aquaculture sector

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Abstract

The COVID-19 pandemic is now spreading throughout the world affecting the agricultural activities including fish and shrimp culture sectors. Most of the shrimp producing countries particularly in South-east Asia have been affected due to the lockdown, quarantine roles and regulations ordered by the countries, which was assigned to reduce and control the COVID-19 pandemic spreading in the globe. The current establishment of the restriction and quarantine roles has significantly reduced the domestic and international transportations that can seriously affect the shrimp supply chain in the world. Further, the labor shortage, delay in shrimp harvesting and insufficient supply for the processing of shrimp in the plants are other impacts due to coronavirus outbreaks. The impacts of COVID-19 disease on world shrimp aquaculture can be numerous and is varied depending on the several factors. For instance shrimp culture in some countries such as India and Thailand could be seriously affected by insufficient SPF-shrimp broodstocks, labor shortage, transport restrictions, delayed harvesting (results in soft-shell shrimp) and uncertainty in shrimp trade whereas in other regions including Indonesia and Vietnam the Coronavirus-side effects on shrimp industry are relatively low. This review addressed the socio-economic impacts due to COVID-19 on the shrimp aquaculture sector in 2020.

Keywords: COVID-19, Coronavirus, Shrimp culture, Shrimp trade, socio-economic, Lockdown

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Introduction

The international trade has faced different challenges over the past year and the year

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ahead. Last year showed a challenge for global trade. The world's two largest economies, China and the United States, were embroiled in a trade dispute, and progress in the negotiations was slow. This challenge has slowed down global trade in many large economies (UN, 2019). The global seafood market is very sensitive to stressful economic conditions so that the combination of decreased demand and the introduction of multiple tariffs had major implications on international seafood trade before the end of 2019.

After 4% growth in 2018, the total value of seafood trade in 2019 fell by 1.42% to $ 160.5 billion, which was accompanied by a decrease in volume (OECD-FAO, 2019). Compared to 2018, global production of farmed shrimp increased by 17% and reached 4.45 million MT in 2019. Approximately 85% of global shrimp production performed in Asia, with increasing production in China, India and Indonesia. Ecuador, the top Latin American producer, produced more than 600,000 MT in 2019, which was 13-15% more than that of 2018 (GLOBEFISH, 2020a).

Wild fish now make up 45% of the fish we eat, and its share continues to decline (FAO, 2020). Fish and fish products (fish for human consumption and fish food) are among the best-selling foods traded in the world. Countries are expected to steadily increase their export of the global fish trade for human consumption. By 2028, exports of fish and fish products are projected to account for about 36% of total production. Global fish trade for human consumption is projected to continue to grow more slowly over the next decade (OECD-FAO, 2019).

The Global Shrimp Market is estimated to be worth approximately US$ 25 billion by 2026 (Cision, 2020). The world's shrimp production in 2019 exceeded 4.5 million tons, which the global fishing and shrimp production (8 million tons) indicates a relative increase in shrimp production compared to its catch throughout the world (GLOBEFISH, 2020b).

The COVID-19 Coronavirus has spread across the world (Bennett *et al*., 2020) and has become a major challenge for shrimp producers and exporters in producing countries, as falling prices will reduce banks' willingness to lend to the sector (Matilde, 2020). The shrimp culture industry is one of the most important sectors among the seafood industries will be probably affected by the Coronavirus crisis. Contrary to the expectations for shrimp production in 2019, which production of India and Ecuador had been predicted for 580k and 600k MT, the values were surprisingly raised to around 800k and 635k MT (Matilde, 2020). Their exports to China were increased by + 300% and + 261%, respectively compared to 2018 (GLOBEFISH, 2020a).The Ecuadorian shrimp price was 5.53US$ per kilo in April 2020 compared with that of the same time in 2019 showed 5.73 US$. In 2019, the focus of shrimp exporters worldwide was on China, where imports increased significantly. Simultaneously, exports from Thailand (+58%) and Vietnam (+177%) to China were also reported while the three main markets for shrimp imports were the

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European Union, China and the United States (GLOBEFISH, 2020a).

Due to the Coronavirus (COVID-19) pandemic and the increasing demand for safe animal protein in human consumption, fish consumption is on the rise, which has not only caused major changes in the global economy but also affected the buying behavior of many people around the world (Edward Gnana *et al*., 2020).

The objective of this review is to focus on the influence of Coronavirus (COVID-19) on farmed shrimp production and trade throughout the world.

Hatcheries

COVID 19-related restrictions have almost shut down the global aviation system worldwide. This is having a major impact on imports of more SPF shrimp broodstocks due to border closures or other some domestic limitations. Not only hatcheries need SPF broodstocks, but they also need artemia, larval food, and many other items that can be used in hatcheries (Abhimanyu *et al*., 2020). The effect of lockdown can be increased through the shrimp-producer countries while their infrastructures including processing centers, hatcheries and farms have a great distance from each other.

Shrimp feed

The shrimp feed industry is heavily dependent on-farm operations so that the poor on-farm storage activity has led to a reduction or closure of feed mills that produce feed for farm shrimp. Locking has further affected the transportation of raw materials such as fish meal, soybean meal and fish oil resulted in activities obstacle of feed mills (Abhimanyu *et al*., 2020; Edward Gnana *et al*., 2020).

Shrimp processing

The global lockdown has greatly pushed the normal processing supply chain of shrimp exports. Doubtfulness in importing traders and issues associated with orders and export practices have complicated Indian exporters to maintain a wait-and-see policy. These effects have quickly spread from exporters to retailers, processing plants and hatcheries. Because many links in the export value chain have been broken, farmers cannot harvest their yields, however, finding the domestic market is very limited in the "off mode" (Abhimanyu *et al*., 2020).

Labor and other requirements

Although some skilled workers were stationed in hatcheries and farms, technicians and farm owners travelled from nearby towns or cities. Many of them were unable to visit farms regularly, and although cell phones contributed to some of the farmers. Many state government departments allow shrimp feed to be transported by road during the lockdown, but some small farmers might not be able to meet some of their needs (Dao, 2020d). Shrimp must be fed in a timely manner for healthy and disease-free growth. Delay or inadequacy in feeding shrimp may also affect the average final weight and ultimately the total harvested biomass. Restrictions on-road handling prevents easy access to aquaculture inputs, especially for small farmers who need frequent transports and fewer farm inputs. The money circulation system is also under severe pressure

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because shrimp farming depend on the private money circulation system (CIBA, 2020).

Due to COID-19 Coronavirus pandemic, the rank of some criteria associated with the decline of shrimp production is shown in Figure 1. The scores were collected from some evidence, region experiences and farmer interviews (Abhimanyu *et al*., 2020; CIBA, 2020; FAO, 2020; GLOBEFISH, 2020b). The results showed (Fig. 1) that globally, the upmost worry of shrimp farmers was uncertainties of shrimp export specifically from India and Ecuador, the two largest shrimp producers. This score was decreased for the second half of 2020. Due to the great quantity of SPF-broodstocks importation to each producing-country the worries of farmers was greater for the second half of 2020 than the first half. According to evidence (CIBA, 2020) shortage of skilled workers and lack of transportation associated with required items for farms are the subsequent criteria.

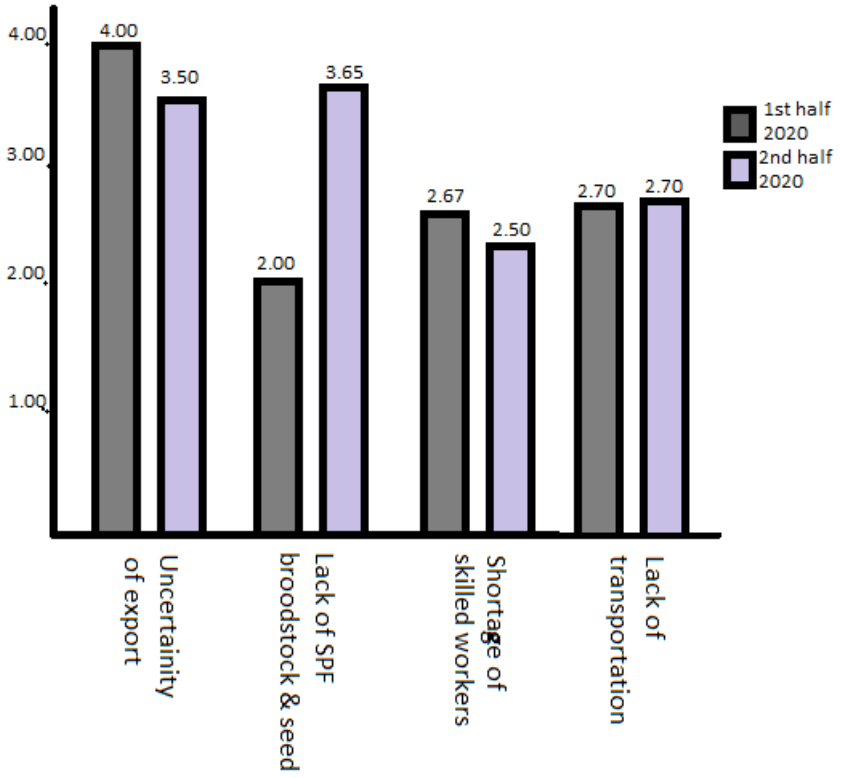

Figure 1. Prognosis and challenges faced by shrimp farmers due to COVID 19 lockdown: results are presented as mean score through the first and second half of 2020.

The socio-economy status in some regions

India

Data obtained from the Indian Ministry of Trade and Industry show that shrimp production increased by 31% year-on-year between 2019 (804,000 MT) and 2018 (615,692 MT) and shrimp exports raised by 8%. These exports to different countries (667,140 MT) represent 83% of the total shrimp production in 2019. Exports in the second half of last year (2019) were pushed forward significantly by increasing US demand so that

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India was able to become the main exporter of shrimp to the United States in 2019. Exports to that market grew by 14% in 2019 to about 282,584 MT compared to 247,783 MT in 2018. Indian shrimp export in 2019 was 159,785 MT to China, 73,702 MT to the European Union (EU); 39,688 MT to Japan; 31,727 MT to Vietnam; 24,645 MT to UAE and 56,762 MT to other destinations (Edward Gnana *et al*., 2020). Prices of shrimp decreased by \$4.70 Kg^{-1} for 40 individuals as on 15 March 2020 compared to \$5.00 Kg^{-1} showed 6.5% reduction for the same size at the end of February 2020 (Dao, 2020b). This value represented a declining trend in shrimp price in 2020.

Until COVID-19 restrictions were announced by the government of India, approximately 63,430 broodstock shrimp have gradually imported India in the first quarter of 2020, which was increased by 32% compared to the same period in 2019 (CIBA, 2020) showing adequate shrimp broodstocks to prepare required PLs for farmers, but no new ones imported since the lockdown. The 16 billion larvae were produced in India by March 2020, of which about 1 to 1.5 billion were discarded by hatcheries due to lack of demand from farmers, disrupting the hatchery's shrimp production cycle (CIBA, 2020). It is estimated that approximately 4 billion PLs were produced in April 2020 during the lockdown (Edward Gnana *et al*., 2020). Due to strict regulations related to the production of the PLs, including transportation and labor shortage, hatcheries were unable to produce PLs in the first period of restriction. Also, vehicle drivers were not available to transport PLs to remote areas (CIBA, 2020).

Due to restrictions, inadequate imports of SPF shrimp broodstocks, reduced production and high demand for PLs, its price has increased by about 30% in the second quarter of 2020, and a further increase is likely in third quarter unless conditions change. April is the stocking season for Indian shrimp farms, while the COVID-19 lock has put the entire breeding process on hold. Although the government has allowed import aquaculture items including PLs, most farmers have not started stocking due to many other restrictions that have affected regular farm work (Abhimanyu *et al*., 2020). Some exporters could not access a hygienic certificate for export due to blockage of some laboratories. They could not certify their products for shipments to South Africa, Europe and Australia. These problems have led to lower shrimp prices in India in mid-April 2020, so that this shrimp price in Odisha decreased the lowest level like in the summer 2018. As such, the minimum price was \$ 3.40, \$3.00, \$2.75 and \$2.75 per kilogram for 40, 51, 60 and 70 pieces, respectively compared to \$3.55/ kg in May 2018. With these low prices, shrimp farming in India is likely cannot be maintained its profitability (INFOFISH, 2020). Also, if shrimp broodstocks imports will not meet demand, hatcheries may use domestic sources as non-SPF broodstocks to produce PLs to supply farmer demands, which clearly affects the quality of the PLs. Normally, survival of nauplii is low during summer, which could lead to a sharp decline in PLs supply after May 2020 (Edward Gnana *et al*., 2020). The shrimp sector

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in India is gradually recovering from the COVID-19 epidemic, with more workers returning to the processing centers. The workforce in processing plants decreased by 40% compared to the pre-Coronavirus period, as many workers have not been able to return to work (CIBA, 2020; Dao, 2020d). Millions of workers in India have remained in big cities following lockdown imposed since late March 2020. Many of them decided to go home and never go back to work, although restrictions on fisheries have been lifted since early April. In Andhra Pradesh, there was a severe shortage of workers from March 24 to the end of April, with about 30 percent in areas at high risk of coronavirus exposure. In May and in the other areas with low risk, it increased up to 60% (Dao, 2020d).

Intra-provincial transportation of PLs, inputs and products needed for processing and finally export facilities are of particular importance for the sustainability of shrimp farming in India. Shrimp farming is concentrated in Andhra Pradesh, Tamil Nadu, Gujarat and Odisha, while most hatcheries are available in Andhra Pradesh and Tamil Nadu. As such, processing centers were established in Gujarat, Karnataka, Maharashtra, Kerala and Tamil Nadu (Abhimanyu *et al*., 2020). The price of large size of shrimp (30 pieces kg^{-1}) was $5.74 in week 33, 2020 in Andhra Pradesh vs $4.80 at the same time in Gujarat (Seafood Trade Inteligence Portal, 2020).

In India, the main stocking season for shrimp is March-April. Based on the opinions of Indian shrimp farmers expressed in April 2020 (CIBA, 2020), About 27% of farmers had prepared their ponds but did not stocked shrimp due to the difficulties in accessing healthy PLs and uncertainty about shrimp farming and trade in 2020. About 25% of farms were in the first phase with less than 30 days of culture (DOC), 34% in the second phase with 30 to 80 DOC and approximately 14% of farms had shrimp aged over 80 days. Thus, the days of rearing reflect the pandemic financial impact on shrimp farming, where the first and second phase farms might not consider the investment to be profitable (CIBA, 2020). As such, due to the COVID-19 lockdown, the farming area slumped by 40% in the current season and increases the production cost by 15-20%, which reduces the profit of farmers by 40%. The results of this review indicated that COVID-19 adversely affected the shrimp aquaculture industry so that aquaculture area and shrimp production were respectively fell by 34% and 24%, in the current year compared to 2019 (Fig. 2), indicating shrimp farmers will encounter the constrains associated with the production, fish mill, raw items, and export. In addition, negative impacts on the employment, market price and economic loss to shrimp hatcheries were the other effects of COVID-19 pandemic on shrimp sector (CIBA, 2020). On the other hands, prediction for the area of farms involved in production by end 2020 approximately is 130,000 ha that decreased by 13.6% while production slumped by 25% compared to 2019 (Fig. 2).

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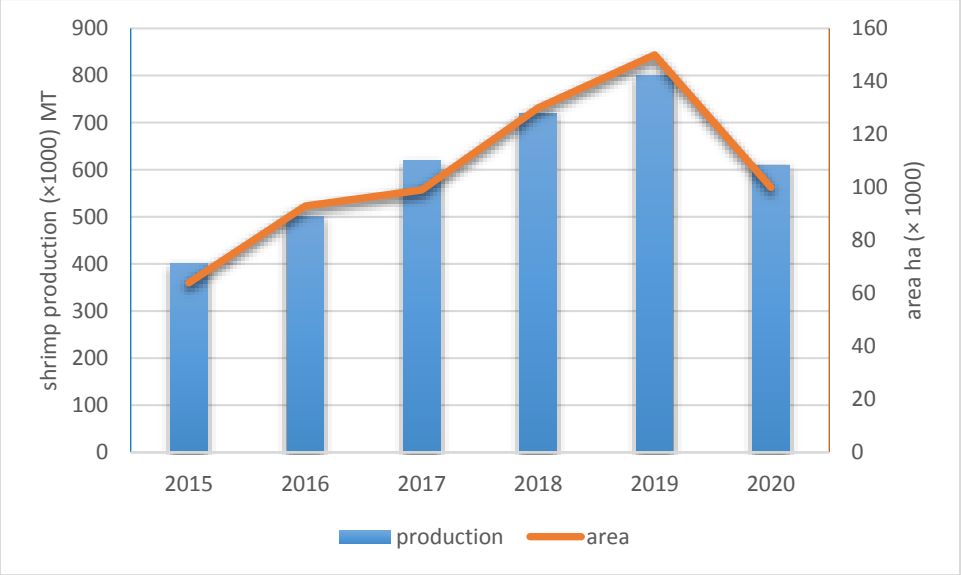

Figure 2. Approximate estimation of reduction in shrimp farming area and production in India in 2020, Source: (CIBA, 2020)**.**

On the other hands, Unlike Ecuador, which exported about 41,000 MT of shrimp to China in April, India exported only 3,000 MT of shrimp to China in the first week of April (INFOFISH, 2020). India, extended limitations in April and May have resulted in severe interruptions in the shrimp supply chain, which PLs supply was at low as same as previous months (Dao, 2020f). In India, prices were up in week 33, 2020 as processors showed an increased demand for raw materials. Prices in this week, however, have shown an unexpected increase. This week, no noteworthy changes in stocking or farming activities were found in India. This rise in processing plant might be associated to Ecuador's recent statement on the weakening of their shrimp output, simultaneously with steady demand from the US market (Seafood Trade Inteligence Portal, 2020). In terms of shrimp production, while the first major crop has not yet been harvested (foretasted in September), it is expected that Indian producers have had a significant reduction in total production this year. During the June and July 2020, Indian farmers have also been facing problems that have led to an outbreak of disease due to unfavorable weather conditions. In general, farmers may not be willing to fully harvest the next crop after September because of the low global demand prices. Indian producers face two major issues next month. One is the September harvest (which will be passed two months after its normal harvest), which will probably coincide with the Indonesian harvest. By increasing the amount of raw materials, this can put more pressure on prices specifically on price of US market. Remember that Indonesia is Indian main competitor in the US market, a market that has not yet shown the recovery and readiness to re-absorb rawer materials. Secondly, in the United States, Indian main market, low prices are likely to encourage US buyers to buy materials, as shown by the increase in the value of products exported to the United States (Seafood Trade Inteligence Portal, 2020).

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Ecuador

Ecuador, a Latin America country, was one of the first countries in the region suffered from the COVID-19 coronavirus (Lozano, 2020). Although shrimp sales to China sharply fell in early 2020 while a historic $ 95 million sale of shrimp exports was recorded in April. In Ecuador, The financial value of lost profits due to COVID-19 pandemic as a whole was $ 12 billion in the first quarter of 2020 (Lozano, 2020). The year 2019 was a top score year for the shrimp culture sector in Ecuador in terms of sales to China reaching 348,000 MT, a trade worth US$1.9 billion compared to 2108 with 98,792MT (Lozano, 2020).

Ecuadorian found that a slight rise for large-sized shrimp (30 pieces Kg^{-1}) in week 33, 2020 vs week 28 ($4.35 to $3.45) encouraging some farmers to restart the shrimp stocking (Seafood Trade Inteligence Portal, 2020).

The prognosis indicated Indian farmers had been faced to a shrimp PLs shortage by 50% at the first half of the year (CIBA, 2020). The COVID-19 coronavirus has been detected from the samples of the outside shrimp packaging of some Ecuadorian exporter found in five boxes in the Chinese city, Chongqing (Harkell, 2020a). On the other hands, exporters insisted that it could be secondary contamination. At the time of article submission, China has lifted suspension on two Ecuador shrimp exporters (Seaman, 2020a). Totally, the value of Ecuadorian shrimp sales to China fell from $ 271 million in November 2019 to $ 157 million in December. In January 2020, this figure reached $ 169 million and in February $ 182 million while it returned to the market with $ 160 million in March. Ecuadorian believed that the 2020 shrimp production drops by 10-15% compared to 2019 (Lozano, 2020), which could be due to closure the hotels and restaurant as main compartments where main parts of shrimp are being consumed. The shortage of the workers, which was a result of COVID-19 epidemic in Ecuador particularly in first quarter 2020, could affect the shrimp processing. This drop meaning that the whole yields could not be harvested in full-moon, at which the hardest shell is found, and the harvest should be carried out through the lunar cycle (Molinari, 2020). According to the Ecuadorian Chamber of Aquaculture (ECA), total Ecuadorian shrimp exports in May increased by 25% reached 72,000 MT compared to April (58,000 MT), showing a 23% grew in value as $ 392 million. In January 2020, total Ecuadorian shrimp export was low at 49,765 MT with a value of $169 million while the exports of February and March were 59,874 MT and 52,531 MT with the values of 182 and $160 million (Harkell, 2020b). At the first eight months of 2020, most of shrimp exports have transported to Asian particularly to China. In the first five months of 2020 (Fig. 3), Ecuador exported 185,000 MT of shrimp worth approximate $1.0 billion to China, equal to 65.5% of total exports (287.000 MT valued $ 1.6 billion) and 65% of value. (Lozano, 2020; Harkell, 2020b).

Prices for large-size shrimp in Ecuador have dropped in early July 2020 approximate $0.10-0.40 Kg^{-1} for the last harvest. As prices for shrimp in Ecuador are falling, production is set to descent among the COVID-19 pandemic (Seaman, 2020b). on late June 2020, The prices

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for head on-shell on (HOSO) white leg shrimp, were on average $3.80, 3.60, 2.80, 2.60, 2.30 per kilogram, respectively for 20/30, 30/40, 40/50, 50/60 and 60/70 count (INFOFISH, 2020). A lot of shrimp farmers across the world accomplished emergency harvests in March and April, as the COVID-19 virus was spreading and in turn they did not re-stock shrimp at that time. This leaves a gap in the supply of large size (30 pieces kg^{-1}) of shrimp. As such, its prices are slightly rising again in the most producing countries. Due to the lower demand from food supply chain, however, prices are still 15-20% below 2019 (Seafood Trade Inteligence Portal, 2020).

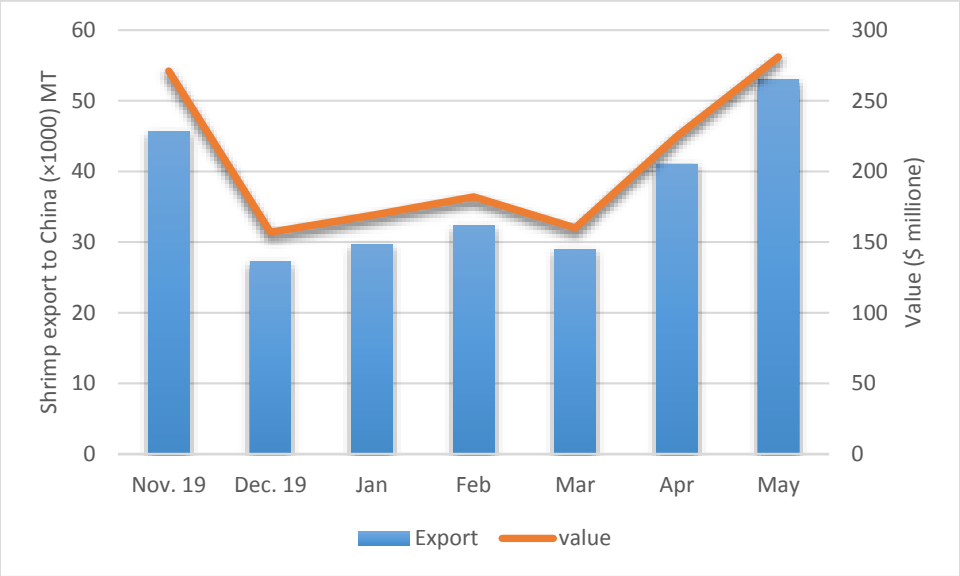

Figure 3. Approximate estimation of Ecuadorian shrimp quantity and its value exported to China in last 2019 and 2020, Source: (Lozano, 2020; Harkell, 2020b).

United States of America

In the major shrimp-consumers countries, including the USA, an expected shift was observed in all types of food favoring retailers in order to control public health measures to reduce COVID-19 spread (Love *et al*., 2020). Compared to 2018, US shrimp import increased somewhat (0.4%) to about 700,000 MT in 2019, an experience that never will meet in 2020. Imports from India grew by 13.7% reached to 282,840 MT, from Vietnam by +3.5% to 61,000 MT, and from Ecuador by +9.3% to 83,000 MT. In December 2019, import orders in the US market increased following a fall in import prices particularly from Ecuador and consumer demand. This increase in supply in January-February 2020, with a cumulative import of 117,000 MT, about 20% more than the same period in 2019, stabilized prices in the new year even lower than previous months. US market has been affected by COVID-19 pandemic. The US imported 38,000 MT of shrimp worth $319.0 million in May 2020, 29% less volume and 28%

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less value than imported in May 2019. That's also below the 51,733 MT worth $439.4 million imported just one month before, in April 2020 (GLOBEFISH, 2020a). India and Indonesia, two major shrimp exporters to the United States, both have good exports in 2020. At this month, India exported 22,229 MT of shrimp to the United States valued $ 187.8 million, $ 8.45 per kilogram, 25% increase in volume and 29% increase in value over the same period in 2019. At the same time, Indonesia exported 13,804 MT of shrimp valued $ 111.8 million, $ 8.53 kg $^{-1}$, 45% increase in volume and 47% increase in value compared to April 2019 (Huffman, 2020b). As shown in Figure 4, the peak of shrimp value was observed in November 2019 ($ 9.15 Kg^{-1}), and went down gradually until May 2020 ($ 8.39 Kg^{-1}). As such, shrimp demand of USA market showed a remarkable decrease in 2020 than the previous month of 2019. Shrimp imported to USA was 67000 MT in November 2019 against 38000 MT in May 2020. This data indicated that COVID-19 pandemic affected the fish market in the USA due to lockdown assigned particularly for public places such as hotels and restaurants where are the main compartments for shrimp consumption. As restaurants activities are performed with fresh seafood such as shrimp, lockdowns resulted in import reduction for live or fresh shrimp and this pressure moved to retailers (Love *et al.*, 2020).

Shrimp imported to the USA was 65110 MT in January 2020 but lessened in later months, which reached 51560 MT with no significant difference to those of March and April 2020 (Fig. 4). As shown in Figure 4, the price of shrimp was gradually slumped since $9.15 kg^{-1} in Nov. 2019 to $8.38 kg^{-1} in May 2020 showing the great negative effect of COVID-19 on shrimp consumption in USA.

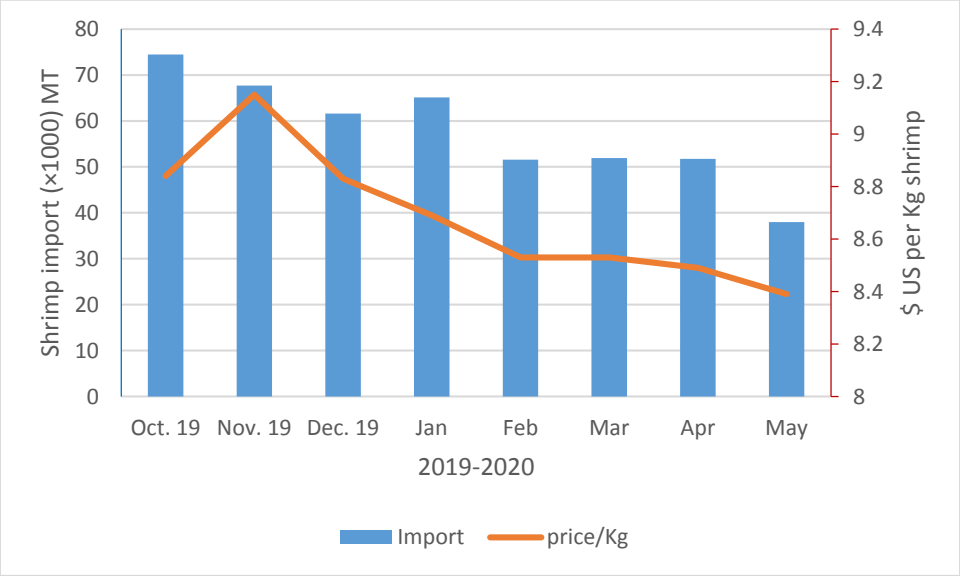

Figure 4. Approximate estimation of shrimp volume and its value $US Kg $^{-1}$ imported to the USA in last 2019 and 2020, Source: NOAA, (Huffman, 2020b).

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China

China plays a crucial role in the shrimp trade and production throughout the world particularly in Asia. Declining demand in China traders is pushing shrimp farmers, especially in Asia, to contractile production. Unfortunately, the outbreak of Coronavirus occurred at the end of 2019 and the beginning of 2020 has faced the Chinese shrimp market to many economical constrains. Shrimp consumption by Chinese people is usually growing during the January new year celebrations, which have dropped sharply this year (GLOBEFISH, 2020a). The first signs of COVID-19 effected on shrimp markets were appeared in the first months of 2020 when national limitations had been stablished. At that time, the restaurant and hotels have not sold any expected volumes (Love *et al*., 2020).

Shrimp export to China was high in the last quarter of 2019, due to well-provision for New Year festival in January 2020. This caused shrimp imports exceeded 700,000 MT in 2019. COVID-19 came and affected China resulted in reduction or cancellation public activities. This led to a dramatic drop in shrimp sales in public guest places such as hotels following the cancellation of many tours and airline tickets as well as domestic-movement limitations. According to evidence (GLOBEFISH, 2020b), major volume of shrimp imported in China was not consumed and trade is waiting for behavior changes of consumers and lifting the limitations in public and open places but appearances showed no any clue of that (Bennett *et al*., 2020; GLOBEFISH, 2020b). This reduction in consumption will cause great losses to Asian and South American producers, who will start their seasons in March-April and April-June, respectively. In early July 2020, Some major buyers in China requested the Ecuadorian traders to lessen the shrimp prices due to cease or remarkable reduction in shrimp consumption in public places (Huffman, 2020a).

It seems that global production of aquaculture will be lower than at the same time last year. Therefore, shrimp exporters are looking to the US and European markets, where are not quite stable for similar reasons. According to the FAO, rising demand for all types of shrimp processed usually conducted for the Japanese Spring Festival (Matilde, 2020) but possibly decreased due to physical restrictions imposed in Japan due to the prevalence of corona. Internal claim for shrimp in the Indian market is suitable; especially for sizes smaller than 70 shrimp per kilogram (values 60 and lower (larger ones) are usually allocated to exports). The main export region of shrimp to the Chinese market in 2019 were Ecuador, India, Thailand, Vietnam, Argentina and Saudi Arabia. Based on the report of the China Aquatic Products Processing and Marketing Alliance (CAPPMA), the value consumption for shrimp in China in 2019 was 2 kg per capita.

Due to strong shrimp import, China has become a major hub for shrimp exporters worldwide. According to Chinese customs, shrimp imports in China in 2019 increased by 179% reached 722,000 MT compared to 2018. In addition, it is estimated that 90,000-100,000 MT of shrimp entered were irregularly entered in China across the borders (GLOBEFISH, 2020a).

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Vietnam

The spread of the deadly COVID-19 worried fisheries officials and shrimp exporters in Vietnam as it delayed the country's exports to China. After sever lockdown in China and expecting the export obstacles, Vietnamese authorities with high level of alert were going to expand the shrimp markets with dispatching delegations to other countries in the first quarter of 2020 (Dao, 2020a). Vietnam export seafood worth $1.23 billion to China in 2019, 23% more than in 2018. Chinese have not to stop shrimp import but receiving cargoes have delayed from Vietnam to Chinese during restrictions. This type of trade resulted in stock growing, which in order adding the cost of shrimp export to China. Due to the effects of COVID-19, the production and commercial activities of seafood companies have been severely affected, especially in the first two weeks of March. The outbreak has forced customers in other countries to cancel or postpone their orders from Vietnamese processing plants, and on the other hands, local producers have struggled to fill orders due to a shortage of materials inside Vietnam. They lack materials for processing and have prioritized retailers' orders (Dao, 2020e). Vietnamese shrimp sector has experienced significant growth in export and agricultural activities, taking advantage of the country's successful control the COVID-19 outbreak (Dao, 2020e) so that it has been performing well recently (Dao, 2020f). Surprisingly, shrimp exports rose 2.6% from January to February worth $ 383 million, largely due to an increase in export to Japan. Shrimp exports to Japan increased by 16% during this period but declined in other major markets. Exports to China and E.U. decreased by 37% and 15%, respectively. In total, Vietnam earned $ 988.8 million from seafood exports in the first two months of this year, down 10.7% from the same period in 2019. Major buyers of Vietnamese seafood in 2020 have been included Japan with $ 184.7 million, up 2.5% from last year, the United States with $ 179.5 million, up 0.9% from the previous year, and the European Union with $ 143.7 million, down 10.9% (Dao, 2020e).

Against other major shrimp-producing countries, with zero COVID-19 mortality reported in June 2020, almost all restrictions and social distance were lifted in the first half of April, and major business activity returned to "normal" mode in late April (Dao, 2020f).

Vietnam Seafood Exporters and Producers Association (VASEP) data show that shrimp exports worth $ 244.2 million increased by 5.8% compared to last year in April 2020. Shrimp exports in the first four months increased by 2.9% year-on-year to $ 872.8 million. Shrimp export to Japan, Vietnamese largest shrimp buyer, rose 19% year-on-year to $ 48.6 million in April, up 11% to $ 180.5 million in the first four months (Dao, 2020f). At the same time, exports to the United States rose 14% reached to $ 43.2 million in April, up 17 percent from $ 158.7 million in the first four months. Of course, Vietnamese shrimp exports to the EU, South Korea and China decreased in third month of 2020 by 16%, 6.3% and 6.4% respectively, in comparison to those of the same month in 2019 due to the COVID-19 pandemic (Lee, 2020). Accordingly, demand for

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Vietnamese shrimp from the United States has been increased by reducing imports from India and Ecuador, both of which are fighting against the spread of COVID-19. Shrimp shipments to China rose for the first time in April this year, up 16.6% from a year earlier worth $ 39.2 million. Vietnam is expected to receive more shrimp orders from foreign customers as its main competitors, including India, Ecuador, Indonesia and Thailand, are still involved with COVID-19 crisis (Dao, 2020f). On the other hands, Vietnamese shrimp prices are going to be steady well with start of the third quarter because of low level of stockpiles in major markets including Japan, the U.S., and the E.U., where the proper alternatives are of China in the crisis compared to previous months (Molinari, 2020).

Due to possible contamination, demand for frozen shrimp increased in China against live ones. Many seafood companies in Vietnam face huge financial pressures due to falling sales prices, high interest rates, increased shipping and stockpile and other costs. The industries' proposals include decreasing the income tax on seafood companies, eliminating road costs for seafood companies and lowering electricity prices for seafood processing plants and cold chain units. Banks have also been asked to offer low-interest loans, extend debt repayment periods and reduce bank charges (Dao, 2020e).

Indonesia

The effect of COVID-19 on the price of *Penaeus vannamei* (white leg shrimp) in Indonesia has been real. The global spread of the disease caused shrimp prices to fall in January, 2020. China, which imported about 700,000 MT shrimp in 2019, reduced its imports in the first quarter of this year due to COVID-19. The decline directly affected shrimp producers, particularly India and Ecuador, the two main exporters of shrimp to the world's largest economies. The fluctuated price led Indian exporters to seek new markets, albeit at lower prices. This movement affected Indonesia exporting shrimp to the United States and the European Union, the two main Indonesian traditional shrimp markets (Fachrudin and Suhendra, 2020). Given that, Indonesia has a very low incidence of the COVID-19 disease (WHO, 2020), the government's restrictive measures have also been low, reducing the impact of the pandemic on the economy and trade. The governors showed a well support during the pandemic. Supply chain was not disrupted for processing plants and hatcheries in terms of PLs and shrimp feeds. Only a few regions complained over the shipment delay, which is normal due to Covid-19 protocols slowing down the transportation. another constrain was increase the feed price from the side of feed millers by 3-4% to USD 1.05-1.06 kg^{-1} in in mid-April 2020 due to the rupiah depreciation which in turn raised the cost of imported feed raw materials. Many shrimp farm technicians or feeding operators as well as skilled workers might be of other provinces returned to their hometowns after harvest which was before COVID-19 lockdown. They could not return to farm due to transport restrictions. Somebody returned to farm but had to be quarantined for 14 days, which led restocking

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to be done with a delay (Fachrudin and Suhendra, 2020).

In early February 2020, Indonesia restricted imports of live fisheries products to be imported from China as part of national, limitations to minimize the transmission of the coronavirus, which was a strike for the shrimp industry in the province Jambi. As such, shrimp export decreased by $ 69,800 compared to $ 1.61 million in December 2019 before the COVID-19 outbreak (Dao, 2020c).

Thailand

COVID-19 pandemic seriously affect agriculture sector of Thailand. Most of Thailand labors are from Cambodia and Myanmar. Many migrant labors are occupied in the shrimp industry have gone back home and cannot return farms. The lockdown and border closure ordered in Thailand in March resulted in their absence from work, which subsequently will affect the Thai productivity and quality of shrimp farms (Saokaew, 2020).

European Union

This region is one of the upmost major consumer of shrimp produced in other countries. Lockdown assigned in the region specifically in Italia and Spain as two major touristic countries where the most part of shrimp could be consumed in hotels and restaurants or open spaces. The weak trend of the 2018 market continued in 2019, and shrimp imports to the European Union decreased by 3.9% compared to 2017, reaching 807,660 MT. All of Europe top markets faced declining imports in 2019 so that shrimp imports to Spain fell 1.2%. France - 3.5%, the Netherlands - 9.9%, Denmark - 8.8%, Italy - 7.5% and the United Kingdom and Northern Ireland + 2.7% showed change in imports. In 2019, EU sources account for nearly 73% of total shrimp imports in 2018, down by 2%. With the exception of Ecuador (+ 27.3%) and Bangladesh (3.3%), the other four major shrimp producing countries have slumped in export to Europe (GLOBEFISH, 2020a).

Iran

Approximately 121,000 MT Iranian seafood worth more than $ 390 million were exported to world markets in the last 10 months of last year. These products were mainly exported to EU member states, Persian Gulf countries, Iraq, Afghanistan, Russia, Vietnam, Malaysia and Thailand. These countries are the traditional markets for Iranian seafood exports. Last year, exports to China and South Korea increased. out of this volume, 28,000 MT worth more than $ 102 million were DEDICATED to shrimp (IFO, 2020).

Of course, Iranian farmers must also adapt to the current crisis. Improving the domestic market, like the experience that Indian traders gained in selling shrimp products in 2018, is another way that could be ahead of the Iranian shrimp industry. The time of lockdown for COVID-19 pandemic was not synchronized with shrimp culture in Iran exception with few hatcheries. A small number of countries, including Iran, have banned the import of broodstocks from abroad, and the need of farmers for SPF and other broodstocks were met from the domestic sources. This situation was difference than other shrimp producing

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countries. Almost the shrimp farming was beginning since May due to fluctuation in weather in March and April in 2020. Thus, it seems that the restrictions were not seriously effective in shrimp farming in Iran. The production will be constant or maybe decreased by 5% due to uncertainty in global shrimp markets.

Perspective

At the time of this writing (August 2020), it has passed 8 months since the first alarm bells of that COVID-19 throughout the world. The COVID-19 pandemic has had a major impact, directly or indirectly, on global shrimp production in 2020. Labor shortage specifically in late moon, when the shell of shrimp is hard, can affect the shrimp cost and trend of traders for export. Because in Asia, shrimp culture mainly begins in the early season (March-April) and due to domestic limitations which in turn made the farm labors back home in Jan-Feb 2020 (not to comeback soon) as well as sever uncertainty in international trade particularly in China and USA, lower densities were stocked in the ponds of most producing countries with a delay in May-June 2020. The situation is also severe in the export processing sector. Harvesting in some Asian countries coincides with together result in abundant raw material for export which in turn the global shrimp price will be collapsed in Sep-Oct. On the other hands, the lockdown ordered in the countries where the crisis is going on, results in insufficient PLs, delay in stocking and lack of transportation and ultimately decrease of annual production. In India, alteration in weather in last months may be shows a worse condition in shrimp yield and trade in late 2020. In Latin America, the supply of farmed shrimp is seasonally low until May/June when Asian market showed low quantities this year due to the afore-mentioned discussion. In addition to shortages of raw materials in producing countries, prevention of contamination of products, social distance regulations and other control measures taken to combat the COVID-19 pandemic, including international and domestic transport systems access to skilled workers will be reduced and processing and shipment of export orders not to be occurred on time. The COVID-19 epidemic has had a strong impact on shrimp demand in international and domestic trade since the beginning of 2020. In the first quarter of 2020, most celebrations and public gatherings in shrimp-consuming countries were cancelled. The impact of COVID-19 on places of catering, especially restaurants and hotels, was much stronger with increasing public uncertainties due to public fears. People's ambiguities are of the health situation of public places. For this reason, most people prefer to stay home. This resulted in preparation by themselves prepare their food, which has led to an increase in the performance of food delivery systems and food retailers. This issue is likely to continue until the end of the year and even the first months of the New Year. Due to declining social activity, many jobs have become inactive or diminished, and incomes in countries have heavily decreased. Therefore, due to declining GDP worldwide, demand for

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shrimp will decrease in all countries up to end of 2020 and people are moving to cheaper foods. In European and North American countries, due to the habit of people living at home, the demand goes mainly to processed shrimp in retail markets, and consequently, the sale of large-sized shrimp, which is mainly served in restaurants, will be reduced. Exporting countries belonging to traditional western markets should do a serious study in Western markets and strengthen their view on domestic markets with the opportunity of domestic sales, as India has experienced in recent years, in order to reduce the serious impact of the COVID-19 on their international trade.

Conflicts of interest

None of the authors has any conflicts of interest to declare.

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