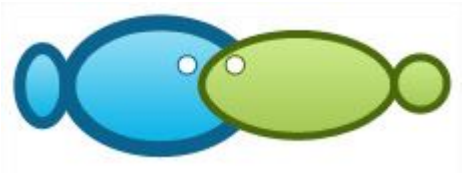

Blue swimming crab supply chain before and during the Covid-19 pandemic against small fishermen in Central Buton Regency, Indonesia (a case study of the Spelman Strait coastal waters)

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Abstract. Unprepared mitigation due to the Covid-19 pandemic caused disruption in the food supply chain. On the other hand, food needs increased along with the implementation of lockdown. It includes one of the blue swimmer crab (*Portunus pelagicus*) raw material suppliers, the Spelman Strait's coastal waters which experienced supply chain disruptions during the Covid-19 pandemic, compared to before the pandemic. This raises concerns that in the future, the Covid-19 pandemic will cause new unemployment. The purpose of this study was to determine the extent of the blue swimmer crab supply chain before and during the Covid-19 pandemic and the role of the Central Buton Regency Government in addressing these problems. The data analysis applied is a socio-ecological system approach based on the spider diagram model. Respondents were selected using the purposive sampling method. Furthermore, the research results showed that the blue swimmer crab supply chain in the Spelman Strait experienced disruption. Since the catch of fishers are not accommodated by the local collectors, exporters did not provide local collectors either. Before and during the Covid-19 pandemic, there was no intervention from the local government in the supply chain. The supply chain that currently works formed its networking independently. Therefore, both central and local governments must have concern and support for supply chain risks for coastal fisheries actors. It can be applied through the formulation and implementation of information systems and network policies.
Key Words: epidemic, government, lockdown, middleman, mitigation, small scale fisheries.

Introduction. It is predicted that the Covid-19 pandemic will last for a long time and feared that it will lead to the potential for a world economic recession, especially in developing countries (Lenzen et al 2020; Nicola et al 2020). Covid-19 pandemic has also caused decrease in gross domestic product (GDP) by 1.8% for developed countries and 2.5% for developing countries (Maliszewska et al 2020).

The Covid-19 pandemic has overwhelmed the world. Unprepared mitigation due to the Covid-19 pandemic caused disruption in the food supply chain. On the other hand, food needs will increase as the lockdown is implemented. This happened in Wuhan City, China, where many economic centres (markets) were closed during lockdown due to excessive public perception of animals as carriers of the virus, including seafood (Jiang et al 2020). As a result, fishery activities have stopped due to falling world prices and demand, such as in Africa, Asia, and Europe. This further leads to decreased fishing efforts, so that export commodities such as grouper, red snapper, crab, and lobster were affected (FAO 2020).

Coastal waters of Spelman Strait, a supplier of blue simmer crab (*Portunus pelagicus*) fisheries, are affected due to the Covid-19 pandemic (Muis et al 2020). The impact is the stopping of the blue swimmer crab supply chain, a mainstay of humble

fishermen to meet their household economy needs. It is feared that in the future, the Covid-19 pandemic will reduce the demand for crabs which leads to fishers losing their livelihoods, causing new unemployment. It is essential to know that before the Covid-19 pandemic, blue swimmer crab supply chain used to flow from the upstream to downstream, meaning that fishers provide raw materials from the suppliers to the end consumers (Das & Lashkari 2017; Kresna et al 2017; Shashi et al 2018; Bharadwaj 2019; Khan et al 2019; Lilimantik & Rafi 2019; Zainol et al 2019; Shashi et al 2021). Sea blue swimmer crab in the Spelman Strait is an export commodity to meet consumers demand abroad, especially in the United States, China, Japan, Malaysia, and Singapore (Statistics Indonesia 2020).

The disruption of the crab fishery supply chain in the Spelman Strait coastal waters will cause economic problems for small fishers who depend on these resources. It is essential to maintain the supply chain and protect the workers involved during the Covid-19 pandemic (ASEAN 2020). In this case, more than 9 million workers in India are dependent on fisheries resources for their livelihoods, and fishing companies in India employ more than 14 million people (Bhat et al 2020). Therefore, the role of the central government and regional governments is needed in minimizing these impacts.

In mid-December 2019, the Covid-19 pandemic was first detected in Wuhan Province, China. The Covid-19 epidemic has had no effect on the supply chain of fisheries goods in Indonesia, particularly crabs from the seas off the coast of the Spelman Strait. In February 2020, Covid-19 pandemic spread in Indonesia and began to affect the fishery supply chains. The coastal waters of the Spelman Strait as a supplier of raw materials (blue swimmer crabs) began to be disrupted by the marketing chain. The blue swimmer crabs from fishers were bought by local collectors in limited conditions and partly diverted to local markets at low prices. Local collectors (middlemen) buy the goods under limited conditions and still maintain the trade relations with fishers and expect the Covid-19 pandemic to end soon.

The Covid-19 pandemic affects almost the whole globe, including Indonesia, particularly in the coastal waters of the Spelman Strait. Despite this issue, no study has been done on the effect of the Covid-19 pandemic on the crab supply chain in the Spelman Strait's coastal waters. This research is the first research conducted in the coastal waters of the Spelman Strait in the Covid-19 pandemic conditions to determine the impact of this pandemic on the crab supply chain, especially for blue swimmer crab fishers.

The purpose of the study was to determine the extent of the blue swimmer crab supply chain before and during the Covid-19 pandemic. This research was fundamental to be carried out in order to find the short-term and long-term solutions, as well as the role of the Central Buton Regency Government in overcoming the impact of the Covid-19 pandemic on the crab supply chain.

Material and Method

Study location. This research was conducted for six months, from November 2019 to April 2020, in the villages on the coast of the Spelman Strait, Central Buton Regency, Indonesia. The community population involved are those who lived in Mawasangka Village, Watolo Village, Kaudani Village, Waburense Village, Wakambangura Village, Mapalenda Village, Kancebungi Village, and Gumanano Village (Figure 1). The respondents of this research were crab fishermen who live in villages on the coast of the Spelman Strait.

Data and data analysis. The respondents chosen as the study subjects were small-scale fishing catchers and local collectors (middlemen) consisting of 45 fishers and three local collectors. Research data were obtained from all actors who contributed to the availability of crabs in the coastal waters of the Spelman Strait, which were determined by purposive sampling. Data analysis used was a modified spider diagram model (Wildenberg 2005). The spider diagram model is a social-ecological system that describes the level of connectivity between research variables. The connectivity is indicated by red

(no connectivity), brown (low connectivity), yellow (medium connectivity), green (high connectivity), and blue (very high connectivity) lines (Rahman et al 2020). The connectivity assessment between domains was done based on the direct observations, interviews, and the Logical Framework Analysis (LFA) results.

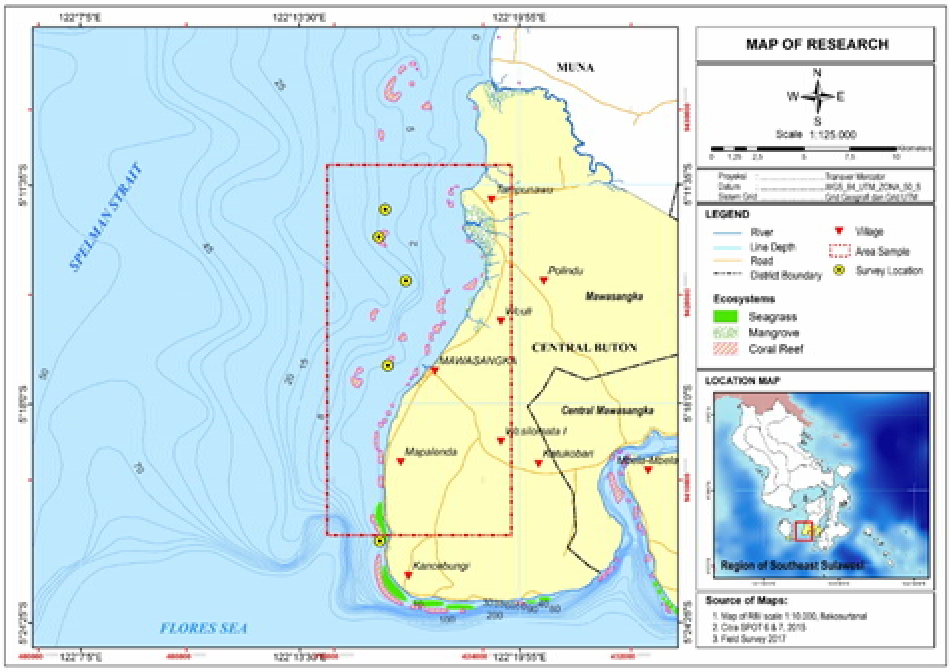

Figure 1. Map of research location.

Results and Discussion

The supply chain of blue swimmer crab. Supply chain is the achievement of the trade process from fishers as suppliers of raw materials to exporters as final retailers (Abduho & Madjos 2018; Nguyen et al 2019). The supply chain is a flow of raw materials and finished materials done well through warehousing facilities as a potential intermediary (Liu & Zhou 2017; Vanteddu & Nicholls 2020). Before the Covid-19 pandemic, blue swimmer crab fishery in the Spelman Strait coastal waters included fishermen as the initial supplier, the local container as the second supplier, and the exporter as the final supplier (Figure 2).

Blue swimmer crab fishery is one of the prime commodities in the Spelman Strait, while other several commodities are reef fish and anchovies. Based on the research results, crab is one of the mainstays of fishers in meeting their daily needs in improving the household economy. Blue swimmer crab fishers sell their catch using a box container.

The results of the domestic container transaction are directly purchased by exporters residing in Gresik City. The blue swimmer crab supply chain during the Covid-19 pandemic experienced a cessation of purchase (Figure 2), compared to before the Covid-19 pandemic. In contrast to what is currently being experienced globally, the Covid-19 pandemic has disrupted almost all supply chains of food needs. In Table 1 there are the crab prices in the Spelman Strait coastal waters before and during the Covid-19 epidemic.

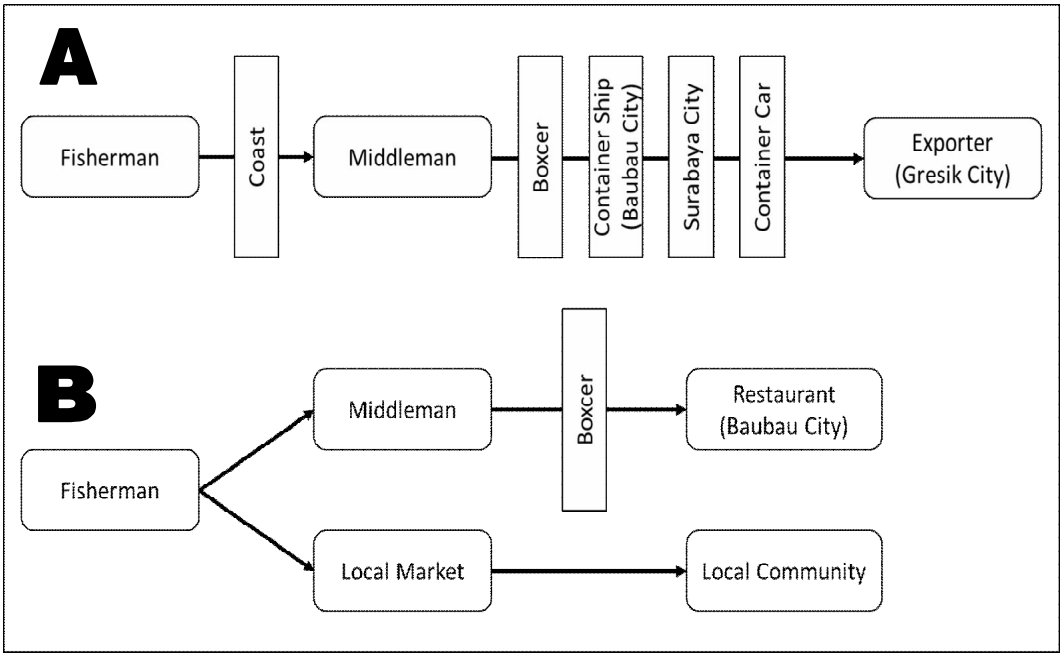

Figure 2. Blue swimming crab fishery supply chain before (A) and during (B) the Covid-19 pandemic.

Table 1

Prices of blue swimming crab before and during the Covid-19 pandemic in the Spelman Strait coastal waters

Price of blue swimming crab (IDR kg^{-1})	*Price of blue swimming crab (packing) (IDR kg^{-1})*	
Middlemen	*Restaurant (during Covid-19)*	*Exporter (before Covid-19)*
35.000,-	-	160.000,-
18.000,-	60.000,-	-

Before the Covid-19 pandemic, the blue swimmer crab market supply chain was well distributed, in which the fishermen as the providers of raw materials, selling their catch to local collectors for IDR 35,000/Kg (equivalent to the US$ 2.47), assuming that 1 kilogram of blue swimmer crabs caught by fishermen equals to 6 to 8 bigger blue swimmer crabs, or 9 to 12 smaller blue swimmer crabs. In comparison, the price of 1 kg of blue swimmer crabs meat (which has been separated from the crab shell) is IDR 160,000/Kg (equivalent to US$11.31) received by the exporter (Table 1).

At the time of the Covid-19 pandemic, the blue swimmer crab supply chain experienced a disruption, where the price of 1 Kg of logs at a local container was bought at IDR 18,000/Kg (equivalent to US$ 1.27). In contrast, the local container experienced supply chain disruptions to exporters because during the Covid-19 pandemic, exporters did not serve purchases, so during the Covid-19 pandemic, fishers sold crabs to middlemen who then sold them to nearby restaurants and local markets and then to the surrounding community, at IDR 60,000/Kg (equivalent to US$ 4.24).

Before the Covid-19 pandemic, connectivity between fishermen as resource users was very high because all catches were directly bought by local collectors (middlemen), and the connectivity between local collectors and exporters was also very high (Figure 3). This connectivity has been ongoing for a long time. During the Covid-19 pandemic (Figure 4), connectivity between fishermen as resource users remained very high. The difference was connectivity with local containers in moderate conditions. Some of the catch is diverted to local markets for household consumption at lower prices, thereby reducing fishermen's income and affecting the welfare of fishermen's families. For this reason, it is hoped that there will be assistance from the central government and local

governments to meet the needs of fishermen's families during the Covid-19 pandemic and to maintain the sustainability of the Spelman Strait crab supply chain as an export commodity.

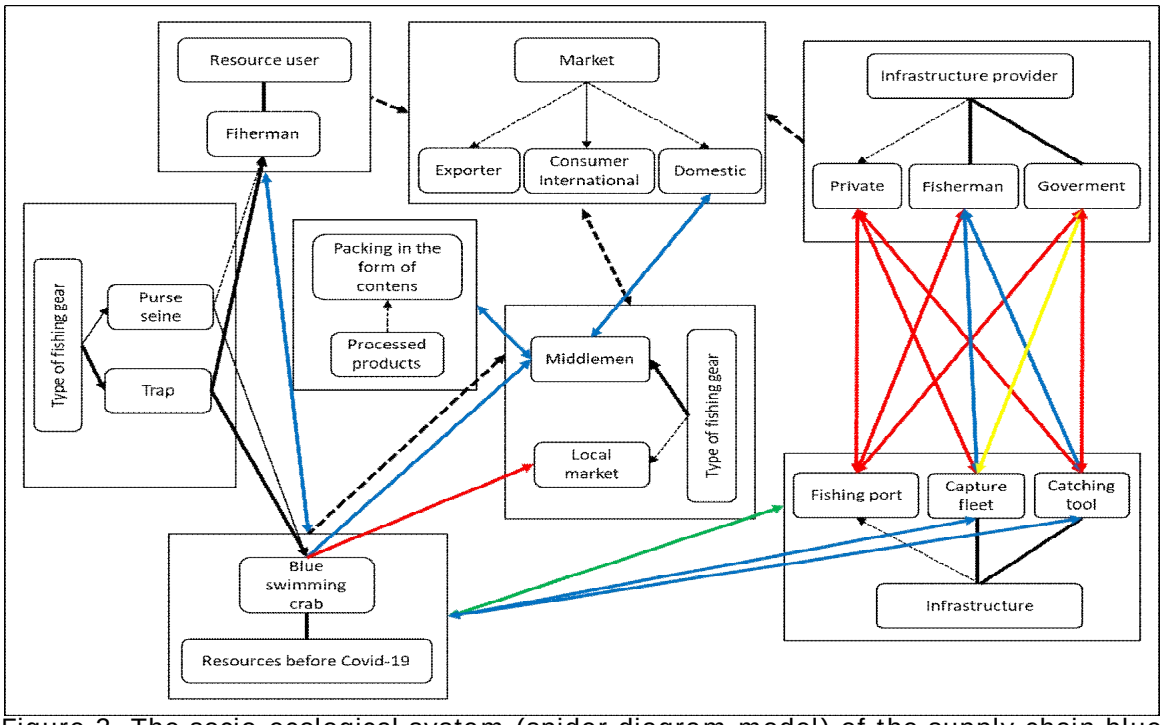

Figure 3. The socio-ecological system (spider diagram model) of the supply chain blue swimming crab before the Covid-19 pandemic.

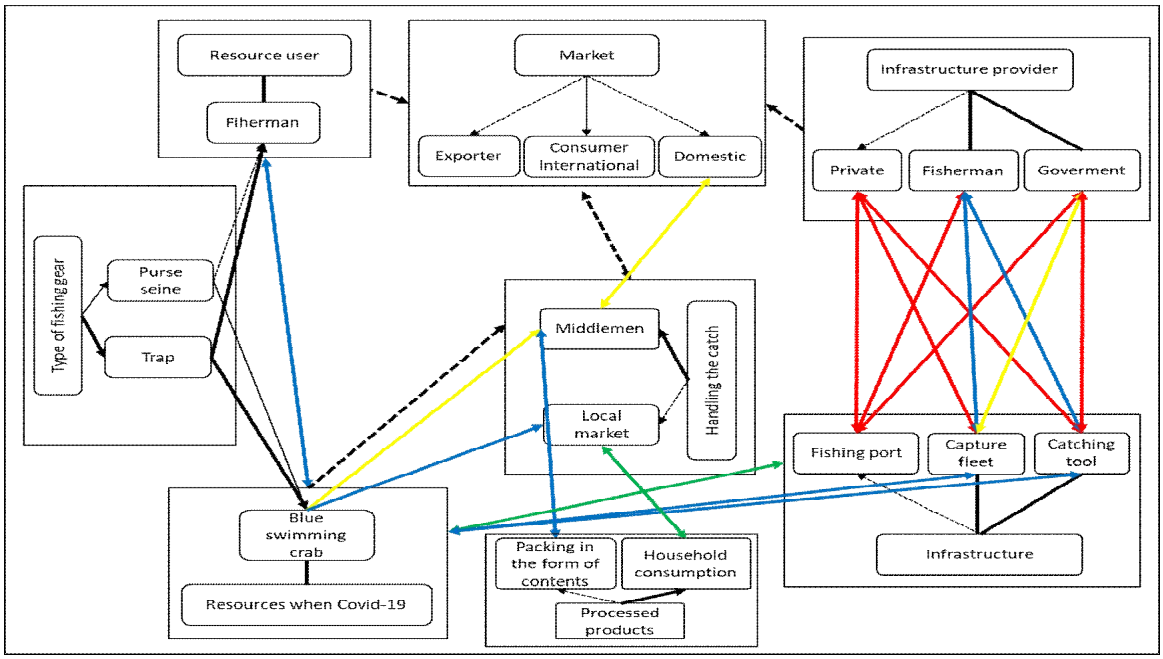

Figure 4. The socio-ecological system (spider diagram model) of the supply chain blue swimming crab during the Covid-19 pandemic.

At first, Covid-19 pandemic made people very careful about consuming seafood because the plague could be transmitted through animals. As reported by Lenzen et al (2020), the initial entry of the Covid-19 pandemic in Wuhan, China caused many animal and seafood markets being closed. This is the result of the misperception that the Covid-19 pandemic originated from animals, thus resulted in a sharp decline in seafood consumption in

several countries in the world (WHO 2020), whereas Covid-19 can only be transmitted through mammals and birds (Hemida & Abduallah 2020). No one has reported that the virus has infected fish, so that humans who eat fish become sick (Boylan 2011; Woolhouse et al 2012). Seafood can disrupt human health if it is not fresh, eaten half cooked, or eaten raw without special treatment. Fresh food may be infected with the Covid-19 virus before being frozen if health procedures are not followed properly during the processing (Huff et al 2015).

When the lockdown requires everyone to stay at home, it causes food consumption to increase and seafood is no exception. One of the ways to maintain body immunity is by consuming blue swimmer crab. There were two issues to be considered during the Covid-19 pandemic: food safety and supply chains. The potential for blue swimmer crab markets in the coastal waters of the Sepelman Strait has penetrated the domestic and global markets. With the enormous market potential, it is hoped that there is a solution amid the Covid-19 pandemic. The disrupted supply chain will threaten the world food and health crisis (Galanakis 2020).

Solution offered. The blue swimmer crab supply chain in the Spelman Strait's coastal waters before the Covid-19 pandemic proceeded normally. Local intermediaries accommodated all the catches of fishers, and exporters provided local intermediaries. Conversely, when the Covid-19 epidemic struck the world, including the Spelman Strait waters, the supply chain experienced a halt. The relationship is illustrated in the following causal loop (Figure 5).

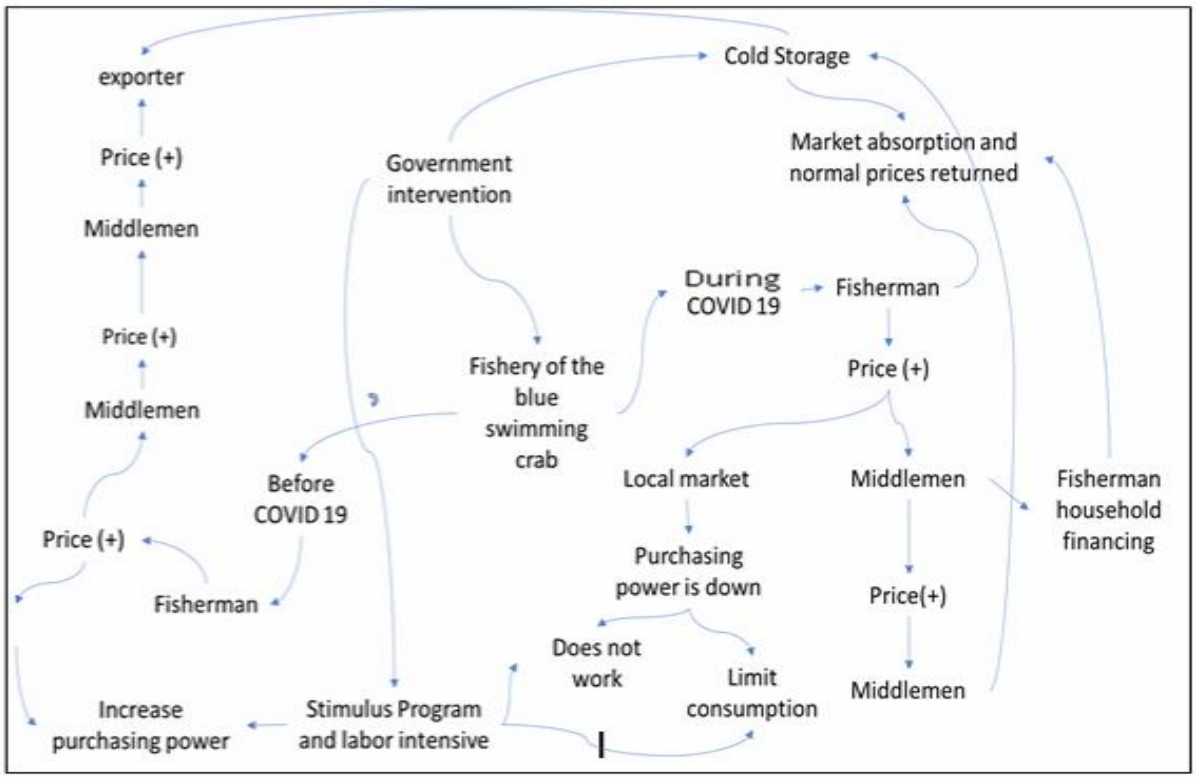

Figure 5. The blue swimming crab causal loop before and during the Covid-19 pandemic.

The blue swimmer crab supply chain before the Covid-19 pandemic was going well and has changed the household economy of fishers because there was still a saving ratio. It is different from during the Covid-19 outbreak. Although the prices were low, not all fishermen's catches could be bought by local collectors and some were sold to the local market.

The blue swimmer crab supply chain has been going on for a long time. The relationship between fishers and local collectors (middlemen) as well as between local collectors and exporters was based on mutual trust and mutual need. One of the things

that can be done to maintain the continuity of the supply chain is to increase mutual trust, so such cooperative relationships can be carried out for a long time and being sustainable even though supply chain relationships are established without local government intervention (Lees & Nuthall 2015). Therefore, during the Covid-19 pandemic, fishers need local government assistance and intervention. In the State of Alaska, government intervention in aquaculture allocates US$ 50 million in aid from a US$ 300 fishery allocation. Attention and protection for small fishers as providers of raw materials were significantly maintained. Workers' and fishermen's social security has been created under stakeholder rules, just as in Alaska (Brehmer 2020; Welch 2020). The issue must come to the attention of the regional government. There is no need to wait for direction or regulation from the central government. Local governments must take the initiative to save small fishers. As in the European Union region, the fisheries sector contributes jobs to roughly 75,000 people. For example, Spain accounts for a quarter of the total employment. Therefore, the industry positively contributes to the surrounding community's economy (The European Commission 2020). Thus, as the highest authority in the region, the regional government must take mitigation measures to prevent new unemployment. Unlike companies with significant capital, mitigation measures have been prepared for problems with the supply chain (Jusriadi et al 2020). Short and long-term mitigation strategies must be devised in the form of big plans.

In the short-term supply chain, it is expected that all catches of blue swimmer crabs are accommodated by the local government in the form of the establishment of regionally owned enterprises (EROE) or fishing cooperatives (FC) and or in collaboration with the private sector. Thus, it can create new jobs that are labor-intensive, so market passion will rise again, campaigning for seafood that has a high nutritional composition value. Therefore, it will worth of advantages to one's physical well-being, especially during a pandemic where the immune system requires highly nutritious food (Lidia et al 2020; Ramadhani & Khofifah 2021). The implication of implementing this policy is that it will stimulate local markets to buy fishermen's catch while waiting for the central government's policy to resume crabs export.

Long-term programs may use a storage or warehouse receipt system, as well as a post-sale system, in the hopes that after the pandemic Covid-19 passes, the dynamic market will be sold once again. To improve the distribution process, it is hoped that cooperation between the government and the private sector will play an active role in providing supporting facilities in the forms of cold storage, refrigerated boxcars, hygienic markets, electricity, drainage, and so on. In addition, local government, together with business actors (private), must also establish networking with universities in the region (Batubara et al 2016; Shashi et al 2018; Shashi et al 2021).

The cooperation takes the shape of long-lasting product developments since fisheries goods degrade rapidly. This cooperation will allow each area to handle the effect of the Covid-19 pandemic on the supply chain, as well as any future occurrences. Especially in the era of regional autonomy embraced by Indonesia, the provincial responsibility is left to the management of each region. Local governments must have the courage to take policies and make quick and proper decisions so that the problems of small fishers as raw material suppliers can be overcome. Collaboration between the central government, regional governments, researchers, the private sector, NGOs and others who have concerns must be realized immediately to save food security by protecting small fishers (Bennet et al 2020).

The Covid-19 pandemic case is a multidimensional crisis that will create a new era (Galanakis 2020). This crisis will also be a lesson for the central government and local governments in raising awareness of supply chain risks in the future. Central and local governments should establish rigorous regulations and policies as well as information and networking technologies so that supply chain players may plan recovery solutions, one of which includes alternative suppliers and future mitigation preparation.

Conclusions. The blue swimmer crab supply chain in the coastal waters of the Spelman Strait requires special attention from the local government in terms of both short term and long term. In short term, it should be in the forms of saving the catch of fishers by

guaranteeing the supply chain, while in long terms, it should be in the forms of preparing mitigation and product standards that are following Indonesian national standards and global standards, as well as strengthen collaboration with professionals.

Acknowledgements. Small fishers are providers of raw materials for large, medium, and small industries and the food security of an area or nation. Therefore, small fishers need the government's participation in providing access and policies for them to maintain their presence in providing the needs of local raw materials.

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Received: 01 July 2021. Accepted: 01 August 2021. Published online: 21 September 2021.
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How to cite this article:
Salam I., Zani M., Muis, Limi M. A., Taridala S. A. A., 2021 Blue swimming crab supply chain before and during the Covid-19 pandemic against small fishermen in Central Buton Regency, Indonesia (a case study of the Spelman Strait coastal waters). AACL Bioflux 14(5):2688-2697.