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Impact of COVID-19 on marine fisheries supply chains: Case study of Malaysia

Zarul Hazrin Hashim\textsuperscript{a,b,*},\textsuperscript{†}, Mohamad N. Azra\textsuperscript{c,d,*}, Mohd Iqbal Mohd Noor\textsuperscript{e,f}, Nor Azman Kasan\textsuperscript{g}, and Shau Hwai Tan\textsuperscript{b,*},\textsuperscript{†}

\textsuperscript{a}School of Biological Sciences, Universiti Sains Malaysia, Penang, Malaysia
\textsuperscript{b}Centre for Marine and Coastal Studies, Universiti Sains Malaysia, Penang, Malaysia
\textsuperscript{c}Institute for Tropical Biodiversity and Sustainable Development (IBTPL), Universiti Malaysia Terengganu, Terengganu, Malaysia
\textsuperscript{d}Climate Change Adaptation Laboratory, Institute of Marine Biotechnology (IMB), Universiti Malaysia Terengganu, Terengganu, Malaysia
\textsuperscript{e}Faculty of Business Management, Universiti Teknologi Mara Pahang, Raub, Pahang, Malaysia
\textsuperscript{f}Institute for Biodiversity and Sustainable Development, Universiti Teknologi MARA (UiTM), Shah Alam, Selangor, Malaysia
\textsuperscript{g}Higher Institution Centre of Excellence, Institute of Tropical Aquaculture and Fisheries, Universiti Malaysia Terengganu, Terengganu, Malaysia

\textsuperscript{*}Corresponding authors: e-mail address: zarul@usm.my; aileen@usm.my; azramn@umt.edu.my
\textsuperscript{†}Authors sharing the first co-authorship.

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1. Introduction

Understanding the impacts of the COVID-19 global pandemic on marine resources, especially from the fisheries perspective (i.e., fisheries food supply chain and management) requires all five main components (discussed below) from production to consumption as has been shown by previous studies such as those of Bassett et al. (2021), Coll et al. (2021), Hasan et al. (2021), Lopez-Ercilla et al. (2021), and Love et al. (2021). The COVID-19 pandemic has also affected the four main food pillars of global food security: (i) food availability; (ii) food accessibility; (iii) food utilization; and (iv) food stability (Aday and Aday, 2020; Erokhin and Gao, 2020; Lugo-Morin, 2020; Mardones et al., 2020), with a long-term impact on the supply chain.

A new variant of Severe Acute Respiratory Syndrome (SARS), Severe Acute Respiratory Syndrome CoronaVirus 2 (SARS-CoV-2), attracted global attention and was first reported in December 2019 in Hubei province, Wuhan, China (Khanna et al., 2020). The World Health Organization (WHO) had officially named SARS-CoV-2 as a novel Coronavirus disease 2019 (COVID-19). The WHO also declared COVID-19 a public health emergency, specifically a Public Health Emergency of International Concern (PHEIC), on January 30, 2020. Since the initial outbreak, COVID-19 has spread all over the world, through more than 214 other countries and territories. On March 11, 2020, the WHO declared the COVID-19 a global pandemic. As of June 30, 2020, there was a significant increase in the total confirmed cases and deaths; 10.18 million people were affected and there were 0.5 million confirmed deaths. As of June 30, 2021, as per the situation report of the WHO, more than 181.66 million confirmed cases have been reported, and total deaths have reached 3.94 million globally (WHO, 2021).

The emerging research on COVID-19-related studies represents the importance of addressing recent impacts and future response, not only from a health perspective (Mazinani and Rude, 2021), but also in terms of other
disciplines (and fields) of study such as environments (Azra et al., 2021; Barouki et al., 2021; Sarà et al., 2021; Sharif et al., 2021; Tarazona et al., 2021; Vale et al., 2021; Yang and Lo, 2021), physics (Fernandes et al., 2021), psychology (Sheerin et al., 2021), history (Cavaillon and Osuchowski, 2021), sociology (Lake et al., 2021; Zhou and Guo, 2021), chemistry (Silva-Junior et al., 2021), mathematics (Algehyne and Ibrahim, 2021), engineering (Formentini et al., 2021), and law (Fang and Song, 2021). Thus, interdisciplinarity, multidisciplinarity, and transdisciplinarity fields of research are vital to understand the impact of COVID-19 on human and other related activities and sectors, including food security.

The impact of COVID-19 has also affected other industries such as tourism (Carter et al., 2021; Sharma et al., 2021a), the aviation industry (Dube et al., 2021; Skare et al., 2021), the hotel industry (Hao et al., 2021; Japutra and Situmorang, 2021), the maritime industry (Menhat et al., 2021), the wildlife industry (Merwe et al., 2021), and the food industry (Brooks et al., 2021; Hasan et al., 2021; Langford et al., 2021; Marti et al., 2021; Nakat and Bou-Mitri, 2021; Nordhagen et al., 2021; Rivera-Ferre et al., 2021) with a tremendous number of job losses (Dang and Nguyen, 2021; Posel et al., 2021). COVID-19 has become one of the most recent issues impacting all sectors globally. The final consequences of these social changes are disrupted supply chain and declining stock markets, nationally and internationally (Chowdhury et al., 2021; Khan et al., 2021).

The Food and Agriculture Organization of the United Nations (FAO) defines a supply chain as “A sequence of processes involved in the production and distribution of fish and fishery products from the point of capture to the end market.” It includes fishing vessels, processors, and distributors. Based on the official term provided by the FAO, five main components are involved in the supply chain: (i) production; (ii) processing; (iii) distribution; (iv) marketing; and (v) consumption. The term “supply chain” also refers to the networks of multiple and bidirectional interdependencies between organizations (Hearnshaw and Wilson, 2013). In other words, supply chains are a network of product-related business through which its move (i.e., product, e.g., fish) from early production site to human consumption.

A Movement Control Order (MCO) has been in effect in Malaysia since March 18, 2020, due to rising cases of COVID-19. By limiting citizens’ movement and only allowing critical and essential services and sectors to operate, it is hoped that positive cases of COVID-19 can be controlled.

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1. http://www.fao.org/faoterm/en/.
and thus reduced. The first MCO was in effect from March 18 to May 12, 2020, via legislative procedures, and ordered citizens to stay at home. Only one person per household was allowed to go out for essential business. Interstate travel was banned, and intrastate travel was limited to a 10 km radius only. Interstate or intrastate travelers including employees for nonessential services, were required to apply for movement permits from any police station. It was during this first MCO that there were rumors via social media (e.g., WhatsApp, Telegram, Facebook) and among citizens that it was hard to get marine fish supplies although hypermarkets and grocery stores were allowed to operate as usual if they abided by the standard operating procedures (SOPs) given. While some citizens still decided to go out by following SOPs, some decided to use delivery services as well as booking and purchasing via phone and online, which included the use of social media. To determine the effect of the MCO on fish supplies and the preferable purchasing methods by citizens during the first MCO, a set of questionnaires was developed in multiple languages and distributed via social media.

Marine resources can be defined as biological resources in the ocean, which includes organisms, genetic or population resources, or any other biotic component of ecosystems with actual or potential use of value for humanity. The ocean contains unique biodiversity and provides valuable food resources to humans (Sala et al., 2021). Marine resources from the ocean such as from aquaculture and fisheries-related activities are important for human protein food resources (Fiorella et al., 2021; Flueurence et al., 2012; Maulu et al., 2021; Naylor et al., 2021). However, the COVID-19 pandemic’s effects have affected global supply chains (Belton et al., 2021) and the most particularly worrying sector is food security (Nchanji and Lutomia, 2021; Nechifor et al., 2021; O’Hara and Toussaint, 2021; Pakravan-Charvadeh et al., 2021; Shupler et al., 2021). It is important to understand the potential risk of COVID-19 on the marine fisheries supply chains and its associated impacts for further policy recommendation, coping strategies, and future planning for the related government agencies.

Accompanied by MCOs in most countries and quarantine worldwide as well as closing of borders, the COVID-19 pandemic hit the seafood industry heavily. COVID-19 can affect food supply chains, especially the fisheries supply chain and resources, at local to global scales. Previous studies have found that the pandemic has affected the food industry supply chain in other Southeast Asian countries such as Myanmar (Belton et al., 2021), Indonesia
(Elsi et al., 2020; Layona and Yulianto, 2021; Paganini et al., 2020; Rozaki, 2020; Widi et al., 2021), the Philippines (Go et al., 2020), and Thailand (Wannaprasert and Choenkwan, 2021). Studies on the impact of COVID-19 on marine fisheries resources and supply chain are limited. In addition, there are particularly few studies on the impact of marine fisheries supply chains by the fisheries sector in Southeast Asian countries and regions. Thus, local assessment to evaluate the effects of the COVID-19 pandemic and related emerging control measures on the Malaysian marine supply chain are required, especially through the combination of research surveys and systematic literature review (SLR).

A brief history of systematic reviews was published online by Pericic and Tanveer (2019). Systematic reviews were first introduced by James Lind in 1753, and grew in the late 1970s to 1980s, focused on the need to improve the evidence synthesis of the available literature. However, in 1972, a textbook entitled Effectiveness and Efficiency: Random Reflections on Health Service was published by Archie Cochrane. This textbook drew attention to the importance of comprehensively and systemically summarizing existing research areas, also known as systematic literature review (SLR). SLR is very useful for evaluating and interpreting the current literature and research topic area as well as phenomena of interest for a particular subject area such as medicine (Azzeri et al., 2020; Bayramzadeh and Aghaei, 2021), engineering (Abouzahra et al., 2020; Ahmad and Alsmadi, 2021), computer sciences (Garcia et al., 2018; Sharma et al., 2021b), mathematics (Nogues and Dorneles, 2021; Rakes et al., 2020), energy (Apfel et al., 2021; Weitzel and Glock, 2018), and environmental science (Goulas et al., 2020; Henriksson et al., 2021; Koytcheva et al., 2021; Mengist et al., 2020; Redlingshofer et al., 2020; Rytwinski et al., 2021; Sneegas et al., 2021; Turner et al., 2021).

However, different fields of studies required several strategies for capturing all relevant sources of evidence. For example, from a healthcare perspective, the PICOTS (Population, Intervention, Comparator, Outcome, Timing, Setting) framework is essential to define the possible related research question to publish the SLR. In environmental science, the minimum requirements of PICO (Population, Intervention, Comparator, Outcome) need to be adopted to the research questions. In addition, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) is one of the requirements for the authors to assess the quality of the SLR’s methodologies. Previous studies revealed that only four
countries (Myanmar, Indonesia, the Philippines, and Thailand) have carried out investigations on the impacts of COVID-19-related issues with the food supply chain.

The main purpose of this paper is to evaluate the impact of COVID-19 on marine food security supply management in Malaysia. To achieve this, the study systematically and specifically addresses the following objectives:

i. To review available literature on Southeast Asia food supply management and COVID-19.

ii. To conduct a survey on purchasing method preferences and perception on marine fish supplies availability.

iii. To recommend relevant intervention and policy development to improve well-being and livelihood status among the study population.

This study shows an overview of marine food supply management in the COVID-19 pandemic. An improvement could be made based on the gaps identified by the systematic review. Then, the survey represents a first baseline useful study to address future disaster-driven responses, thus facilitating mitigation plans for future references such as economic initiatives (i.e., economic stimulus packages).

2. Materials and methods

This is a cross-sectional study on the Malaysia marine food supply management in the COVID-19 pandemic. The process of data collection is divided according to the study objectives. First, desk research on the available literature on Southeast Asia marine food supply management and COVID-19 is conducted. Then, a survey is conducted with the chosen study population to describe purchasing method preferences and perception on marine fish supplies availability. Lastly, a recommendation is shown based on relevant systematic review results and findings obtained from survey results. The detail of systematic review method and survey method is shown below.

2.1 Systematic review

2.1.1 Search strategy and flow of study selection

The search strategy for the first objective was structured according to the guidelines provided by the Collaboration for Environmental Evidence and the Reporting standards for Systematic Evidence Syntheses (ROSES) (Haddaway et al., 2017). It focuses on identifying published articles that have reported on the impact of COVID-19 in Southeast Asia marine food
security supply chain. For the purpose of this review, the keywords related to “Food Security,” “COVID-19,” “Supply Chain,” and “Southeast Asia” were used in combination with associated keywords (Table 1). A structured and systematic electronic search strategy was conducted using the traditional search and citation forward and backward tracking with two computerized databases: Web of Science (WoS) and Scopus. The literature search was done in June 2021.

The search terms were combined using the Boolean operator “OR” and “*” for single characters. The keyword was combined into a search string using the Boolean operator “AND.” Search terms were limited to English language due to global focus of the review and the English language is the lingua franca of current academic writing. Recorded references were imported into an EndNote library where all duplicates were removed, and their numbers were recorded.

| Term used          | Keyword               | Search string                                                   |
|--------------------|-----------------------|-----------------------------------------------------------------|
| Population terms   | Food Security         | (“food security*”) OR (“nutrition security*”) OR (“food availability*”) OR (“food utilization*”) OR (“access to food”) OR (“food insecurity*”) OR (“food safety*”) OR (diet) OR (“food supply*”)) |
|                    |                       | AND                                                             |
| Supply Chain       |                       | (“supply chain*”) OR (“value chain*”) OR (“production chain*”) OR (“food supply*”) OR (“procurement”) OR (outsourcing) OR (“commodity chain*”) OR (“food production chain*”) OR (“post production chain*”) OR (“supply chain performance*”) OR (“supply chain network*”) OR (“supply chain system*”)) |
|                    |                       | AND                                                             |
| Southeast Asia     |                       | (“Cambodia”) OR (“Myanmar”) OR (“Vietnam”) OR (“Thailand”) OR (“Laos”) OR (“Indonesia”) OR (“Malaysia”) OR (“Philippines”) OR (“Brunei”) OR (“East Timor”) OR (“Singapore”) OR (ASEAN) OR (“South East Asia”) OR (“southeast asia”)) |
|                    |                       | AND                                                             |
| Intervention terms | COVID-19              | (“COVID-19”) OR (pandemic) OR (coronavirus) OR (“SARS CoV 2”)) |
The flow of the study selection is shown in Fig. 1. Potentially relevant articles were retrieved through two databases (Scopus and WoS). All articles were examined for duplications and duplicate articles from the databases were removed. Title and abstract screenings were carried out on the articles. Articles that were found to be relevant and published in the specified time frame were included. Subsequently, a full-text screening was conducted on the remaining articles. Articles that did not fulfill the inclusion and the exclusion criteria described were then excluded.

**2.1.2 Article screening and study eligibility criteria**

**2.1.2.1 Article screening**

Articles were evaluated based on two levels of eligibility criteria: (i) title and abstract stage; and (ii) full-text stage. First, the articles were evaluated by two
authors independently based on title and abstract. The authors extracted the information such as the study design, the measures of impact, and the reported outcome in a standardized evidence table. To control for reviewer consistency, data were compared, and disagreements were resolved by discussion in order to reach consensus for the screening to continue. Following title and abstract screening, the full-text article was retrieved. Each obtained full-text article was screened by one author. The original screening and validity appraisal criteria were reviewed to reconcile disagreements during kappa analysis, at each level of screening, between all the authors. Cohen’s kappa is a statistical method to test interrater reliability. A systematic review needs to test its interrater reliability in order to minimize potential sources of error and gain high confidence for its study findings and conclusions. A good systematic review needs to be transparent, replicable, and a clear inclusion criterion. Cohen’s kappa method ranges from $-1$ to $+1$, where 0 represents the amount of agreement that can be expected from random chance, and 1 represents perfect agreement between the reviewers (Cohen, 1960; Kottner et al., 2009). Cohen suggested the kappa result be interpreted as follows: values $\leq 0$ as indicating no agreement and $0.01$–$0.20$ as none to slight, $0.21$–$0.40$ as fair, $0.41$–$0.60$ as moderate, $0.61$–$0.80$ as substantial, and $0.81$–$1.00$ as almost perfect agreement. The data is deemed insignificant when kappa values are below 0.60, as this means the confidence intervals are sufficiently wide and that about half the data may be incorrect. However, Cohen’s kappa has its own limitations. It was designed to take account of the possibility of guessing, but the assumptions it makes about rater independence and other factors are not well supported, and thus it may lower the estimate of agreement excessively. Furthermore, it cannot be directly interpreted, and thus it has become common for researchers to accept low kappa values in their interrater reliability studies.

2.1.2.2 Study inclusion criteria

The final criteria to include the articles were as follows:

I. Relevant subject/population: articles that mention marine food security in Southeast Asia as its main objectives. Studies that focus on multiple countries but still involve Southeast Asia countries will be included.

II. Relevant types of intervention: studies that involve COVID-19 as intervention or exposure are included.

III. Relevant outcome: any of the outcomes involving study population and intervention will be included.
IV. Relevant study design: include empirical and analytical studies. Based on this criterion, simulation studies, reviews, and policy discussion are excluded from this review.

V. Language: full text written in English.

2.1.3 Study validity assessment
Each article retrieved for full-text assessment was analyzed using a qualitative comparative assessment (QCA). This is a standard quality assessment of the articles conducted using the checklist and approach provided by the Health Technology Assessment Unit Initiative (Kmet et al., 2004). The checklist includes five assessment criteria: (1) the question/objective is sufficiently described; (2) the study design is evident and appropriate; (3) the sampling strategy is fully described, relevant, and justified; (4) data collection methods are clearly described, without bias; and (5) data analysis is clearly described and systematic. The articles were given two points if they satisfied the underlying criteria, one point if they partially satisfied the criteria, and zero if they did not. Following this procedure, the maximum quality score for a paper is 10. To be included, articles had to have a quality standard of more than five.

2.1.4 Data extraction and synthesis
This study adapted the framework by Alinaghian et al. (2020) for its data extraction and synthesis. The data extraction is organized in two categories: (i) descriptive and (ii) thematic (Table 2). The descriptive category consists of multiple information about the articles such as title of the publication, articles citation, year of publication, and location of lead author affiliated institution country. The thematic category revolves around each article key findings. These mainly include the study hypotheses, explaining the impact of COVID-19 on Southeast Asia and Malaysia marine food supply chain. The thematic analysis followed a two-step coding process where first a line-by-line review is done on the articles to identify the key impacts on the marine food supply chain. A code label was assigned from each article to cluster all the info into a common theme. Two of the authors independently performed the coding process; the discussion is done with all authors to create a basis for a robust set of common themes. Table 2 shows the data type and extraction categories for the present study.
2.2 Digital survey

2.2.1 States

The study was carried out in all 13 states in Malaysia within June 1, 2020 until September 30, 2020 through an online web-based survey. Malaysia is located within the Southeast Asia region, divided into two land masses of East Malaysia and Peninsular Malaysia. Peninsular Malaysia had 11 states
(Pulau Pinang, Perlis, Kedah, Johor, Melaka, Negeri Sembilan, Selangor, Perak, Pahang, Kelantan, and Terengganu) and East Malaysia consists of Sabah and Sarawak, along with federal territories of Putrajaya, Labuan, and Kuala Lumpur.

2.2.2 Online survey
The digital survey was conducted with online questionnaire categories to be voluntarily administered to interested participants. The questionnaire was divided by two different questions using the online platform of Google Form, focusing on the background of the respondents and the impacts of COVID-19 control-disease measurements, lockdown, and movement control order. During lockdown periods, an online-based web survey was beneficial for preliminary evaluation of the COVID-19-related situation (Azra et al., 2021). This web survey consisted of both quantitative and qualitative data and is entirely anonymous with detailed narrative and numeric outcomes, which met ethical and methodological principles of human research ethics committees by Buchanan and Hvizdak (2009). The questions were also designed to evaluate the various stakeholders’ perceptions rapidly from various sectors of industry associated with the marine fish supply chain during the COVID-19 lockdown period and movement control order. In addition, this study had some limitations—for example, being unable to control the number of respondents who might have seen the respective form online but declined to participate in it. Another limitation is the fact that we are also unable to calculate the return rate value of the survey.

2.3 Google form
A set of questionnaires assessing fresh marine fish supplies in Malaysia during the MCO were developed (Appendix) for an online survey. This survey consists of two sections (A: demography; B: the targeted questions) comprising 8 and 10 questions, respectively, which were prepared in four languages (Bahasa Melayu, English, Mandarin, and Tamil). Demography questions include respondents’ age, race, gender, district, state, residential area, job types, and income categories. These questions were included because these are the factors that may influence respondents’ decision making. Multiple choice questions in section B focused on respondents’ behavior in purchasing marine fish supplies prior to and during the MCO. Targeted respondents are all residents in Malaysia, including foreigners. The questionnaires were distributed from June 2020 onward, mainly by using social media platforms
(e.g., Facebook, WhatsApp, and Telegram) and respondents were advised to forward the questionnaire to their friends, relatives, and all groups that they might have in their social media platforms. Occasionally, a re-post was conducted to increase the number of respondents. The questionnaires were also distributed among all local public universities via USM’s Media and Public Relation Office. As of January 2021, the total number of respondents from all four languages was 435, which is about $1.36 \times 10^{-5}$% of Malaysia’s population.

### 2.4 Statistical analysis

All responses from different languages were combined and translated into English in Microsoft Excel®. Frequency for respective answers in section A was calculated by using a pivot table and percentage values are based on total N, which is 435. For section B, as respondents may choose more than one answer, the figures were based on actual frequency. Chi-square test of independence was conducted on question 14, which asked respondents’ opinions on whether marine fish supplies dwindled or not during the MCO. Other variables involved in the analysis include demographic questions, which are age, gender, occupation, types of living area, and average monthly income. This analysis was conducted to determine if the demographic variables influence the respondents decisions. A Chi-square test of independence was conducted by using IBM® SPSS® v26.

### 3. Results

#### 3.1 Systematic review findings

A total of eight articles were considered and included in the review. All of the included articles were descriptive studies. All articles were quantitative studies and empirical in nature. Five studies were conducted in Indonesia, while one was done in Myanmar, the Philippines, and Thailand. Tables 3–5 show the main findings of all eight article such as their title, year of publication, name of the journal, focused country, quality assessment, main methodology, COVID-19-related issue, and main findings of the article within the research areas of COVID-19 and food supply chain and management. Overall, the eight appraised articles have good quality of evidence ranging from 6 to 9 based on the assessment conducted. Summaries of each study are provided below.
Table 3  Systematic literature review findings found in the present research area of Southeast Asia food supply chain during the COVID-19 period.

| No. | Title                                                                 | Year | Journal                                      | Focused country |
|-----|------------------------------------------------------------------------|------|----------------------------------------------|-----------------|
| 1.  | COVID-19 impacts and adaptations in Asia and Africa’s aquatic food value chains | 2021 | Marine Policy                                 | Myanmar         |
| 2.  | Utilization of data mining techniques in national food security during the Covid-19 pandemic in Indonesia | 2020 | Journal of Physics: Conference Series         | Indonesia       |
| 3.  | Utilizing social media technology during the COVID-19 pandemic to assist highly vulnerable populations in the Philippines | 2020 | Christian Journal for Global Health           | Philippines     |
| 4.  | Application for providing the food menu based on available food raw materials, cost, and avoidance for certain diseases | 2021 | Procedia Computer Science                     | Indonesia       |
| 5.  | Growing and eating food during the COVID-19 pandemic: Farmers’ perspectives on local food system resilience to shocks in Southern Africa and Indonesia | 2020 | Sustainability                                | Indonesia       |
| 6.  | COVID-19, agriculture, and food security in Indonesia                  | 2020 | Reviews in Agricultural Science               | Indonesia       |
| 7.  | Impacts of the COVID-19 pandemic on ginger production: Supply chains, labor, and food security in Northeast Thailand | 2021 | Forest and Society                            | Thailand        |
| 8.  | The change of fruit supply chain in response to COVID-19 pandemic in West Java, Indonesia (case study of Anto Wijaya Fruit) | 2021 | Journal of Physics: Conference Series         | Indonesia       |

3.1.1  Review findings paper no. 1: COVID-19 impacts and adaptations in Asia and Africa’s aquatic food value chains

Belton et al. (2021) evaluated the impacts of COVID-19 on the policy response, the availability and price of aquatic foods as well as their production among respondents from Asia (Bangladesh, India, and Myanmar) and Africa (Egypt and Nigeria). The paper was published as a full-length article with a total of 26 authors from 8 countries with the WorldFish as a leading affiliation for the survey. A total of 778 respondents responded to the survey.
from February 2020 until October 2020, with actors from processing categories such as managers/owners of hatcheries, feed mills, feed sellers, fishers, farmers, and smokers, and from distributors categories, traders, and retailers.

### Table 4 Quality assessment and methodology of Southeast Asia food supply chain during the COVID-19 period in the present study.

| No. | Title                                                                 | Quality assessment | Method                              |
|-----|------------------------------------------------------------------------|--------------------|-------------------------------------|
| 1.  | COVID-19 impacts and adaptations in Asia and Africa’s aquatic food value chains | 8                  | Statistical sampling—survey         |
| 2.  | Utilization of data mining techniques in national food security during the Covid-19 pandemic in Indonesia | 6                  | Statistical sampling—secondary data |
| 3.  | Utilizing social media technology during the COVID-19 pandemic to assist highly vulnerable populations in the Philippines | 6                  | Statistical sampling—secondary data |
| 4.  | Application for providing the food menu based on available food raw materials, cost, and avoidance for certain diseases | 7                  | Statistical sampling—survey         |
| 5.  | Growing and eating food during the COVID-19 pandemic: Farmers’ perspectives on local food system resilience to shocks in Southern Africa and Indonesia | 8                  | Statistical sampling—survey         |
| 6.  | COVID-19, agriculture, and food security in Indonesia                  | 6                  | Statistical sampling—secondary data |
| 7.  | Impacts of the COVID-19 pandemic on ginger production: Supply chains, labor, and food security in Northeast Thailand | 6                  | Statistical sampling—survey         |
| 8.  | The change of fruit supply chain in response to COVID-19 pandemic in West Java, Indonesia (case study of Anto Wijaya Fruit) | 6                  | Statistical sampling—survey         |

3.1.2 **Review findings paper no. 2: Utilization of data mining techniques in national food security during the Covid-19 pandemic in Indonesia**

A study by Elsi et al. (2020) used mapping analysis to assess the mean cost per capita expenditure regarding people’s needs for foods during the
| No. | Title                                                                 | COVID-19-related issue                                           | Main findings                                                                 |
|-----|-----------------------------------------------------------------------|------------------------------------------------------------------|-------------------------------------------------------------------------------|
| 1.  | COVID-19 impacts and adaptations in Asia and Africa’s aquatic food value chains | Lockdown and increased infection rates                           | Disruption to aquatic food value chain, availability and price                |
| 2.  | Utilization of data mining techniques in national food security during the Covid-19 pandemic in Indonesia | Active periods of COVID-19 cases in Indonesia                     | Correlation between cost per capita people expenditure for food needs       |
| 3.  | Utilizing social media technology during the COVID-19 pandemic to assist highly vulnerable populations in the Philippines | Lockdown and social distancing                                   | Provide food through social media technology (supply chain)                  |
| 4.  | Application for providing the food menu based on available food raw materials, cost, and avoidance for certain diseases | Active periods of COVID-19 cases in Indonesia                     | Optimize daily food consumption and raw materials during home confinement    |
| 5.  | Growing and eating food during the COVID-19 pandemic: Farmers’ perspectives on local food system resilience to shocks in Southern Africa and Indonesia | Active periods of COVID-19 cases in Indonesia                     | Impacted the local food system and supply chain (small-scale farmers)         |
| 6.  | COVID-19, agriculture, and food security in Indonesia                 | Lockdowns and social distancing, reviewed during active periods of COVID-19 cases in Indonesia | Reviews relationship between food security and pandemic, with coping strategies |
| 7.  | Impacts of the COVID-19 pandemic on ginger production: Supply chains, labor, and food security in Northeast Thailand | Active COVID-19 cases in Thailand                                 | Positive impacts on ginger production and ginger farmer livelihood (price)   |
| 8.  | The change of fruit supply chain in response to COVID-19 pandemic in West Java, Indonesia (case study of Anto Wijaya Fruit) | Movement restrictions and shorter operating time                 | Impacted the fruit supply chain management (distribution)                    |
COVID-19 pandemic in Indonesia. National food security research was carried out in the 33 different provinces in Indonesia (Aceh, North-South and West Sumatra, Riau, Jambi, Bengkulu, Lampung, Bangka Belitung Islands, Riau Island, DKI Jakarta, West Java, Central Java, Yogyakarta, East Java, Banten, Bali, West-East Nusa Tenggara, West-Central and East Kalimantan, South Borneo, North-Central-South and Southeast Sulawesi, Gorontato, West Sulawesi, Maluku, North Maluku, West Papua, and Papua) with two different clusters being used to differentiate the lowest and the highest mean expenditure for food needs.

3.1.3 Review findings paper 3: Utilizing social media technology during the COVID-19 pandemic to assist highly vulnerable populations in the Philippines

A nongovernmental organization based in the Philippines, the International Care Ministry (ICM), focused on a poverty alleviation program for Philippine people and used social media networks to as an alternative platform to continue their service and deliver feeding remotely during the global COVID-19 pandemic (Go et al., 2020). The field report prepared as a collaboration between the ICM team and researchers from Canada started their online services in April 2020 after the implementation of strict lockdown and community quarantine in March 2020.

3.1.4 Review findings paper 4: Application for providing the food menu based on available food raw materials, cost, and avoidance for certain diseases

Layona and Yulianto (2021) developed a web-based application for Indonesian housewives to optimize their food menus based on their availability of raw materials, cost to produce it, and the information on food process and avoidance for certain diseases. Research surveys and development were carried out by both researchers from the School of Computer Science, Bina Nusantara University, Jakarta, Indonesia during the active periods of COVID-19 cases in Indonesia.

3.1.5 Review findings paper 5: Growing and eating food during the COVID-19 pandemic: Farmers’ perspectives on local food system resilience to shocks in Southern Africa and Indonesia

Paganini et al. (2020) examined the impact of the COVID-19 pandemic on small-scale farmers, including challenges and coping strategies in selected urban and rural areas in Indonesia, through a digital survey tool. The paper was published as a research article with a total of 16 authors from 7 different
countries (Germany, Indonesia, South Africa, Mozambique, Zimbabwe, the UK, and the USA) from April 2020 until June 2020, where lockdowns and states of emergency in most countries were first declared.

3.1.6 Review findings paper 6: COVID-19, agriculture, and food security in Indonesia

Rozaki (2020) reviewed the impact and relationship of during and post-COVID-19 global pandemic on Indonesian food security issue, agriculture, and the coping strategies to counter socioeconomic problems caused by this and future pandemics. The overview of the study was done at Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia and was based on the previous literature from most of the tropical countries.

3.1.7 Review findings paper 7: Impacts of the COVID-19 pandemic on ginger production: Supply chains, labor, and food security in Northeast Thailand

Wannaprasert and Choenkwan (2021) evaluated the impacts of COVID-19 on ginger production as well as ginger farmer livelihood during the lockdown period in Phu Ruea district, Loei province in the northeastern region of Thailand. The semistructured interviews, onsite observations, and government records were conducted to collect the 55 ginger farmers-related data from March 2020 until June 2020. The research article was conducted by the Department of Agricultural Extension and Agricultural Systems, Faculty of Agriculture, Khon Kaen University, Thailand.

3.1.8 Review findings paper 8: The change of fruit supply chain in response to COVID-19 pandemic in West Java, Indonesia (case study of Anto Wijaya Fruit)

Widi et al. (2021) determined the impact of the COVID-19 lockdown on the fruit supply chain in West Java, Indonesia. The research article evaluated the impact of movement restriction as the main cause of the problems in fruits distribution. The study used the survey interview in the Anto Wijaya Fruit farms from January 2020 until May 2020. The study was conducted by the School of Business, IPB (Institut Pertanian Bogor) University, a state-run agricultural university based in the regency of Bogor, Indonesia.
3.2 Questionnaire

3.2.1 Section A: Demography

Although the questionnaire was distributed via social media platforms, it reached almost all of Malaysia including east Malaysia, Sabah, and Sarawak. Fig. 2 shows the percentage of individuals from respective states and federal territories who received and answered the questionnaire. Three states with the highest percentage of number of respondents are Selangor with 28.3% \((n=123)\), followed by Pulau Pinang and Johor with 27.8% \((n=121)\) and 15.6% \((n=68)\), respectively. “Others” represent states and federal territories with the number of respondents fewer than 10, with Sarawak being the lowest state, with 3 respondents only. However, Perlis and Wilayah Persekutuan Labuan are missing from the list because there were no respondents from respective state and federal territories. The questionnaires were mostly answered by respondents aged between 30 and 50 years (70.8%), of whom 43% were females and 27.8% were males (Table 6). The second largest respondents’ age group was 29 years old and below with 16.6%, followed by the age group 50–59 years old with 10.1% and finally 60 years and above with 2.5% only. In terms of occupations, 56.3% of respondents work in governmental sectors, of whom 34.7% are females and 21.6% are males (Table 6).

The second largest percentage of occupation is the private sector with 20.7%, followed by those not working (12.6%) and those with their own business (10.35%). Table 7 shows that 76% of the respondents live in a city.

![Fig. 2 Questionnaires distribution and percentage of respondents (Q3; \(n=435)\).](image)

COVID-19 and food supply chain
or a big city and are mostly aged 30–50 years old (50%), followed by those aged 29 and below (12.5%), 50–59 years old (6.6%), and 60 and above (1.8%). The rest of the respondents live in villages in rural areas (12.6%) and small towns (11.6%). Table 8 indicates that 37.5% of the respondents have a monthly income of RM 5001 and above, of whom 25.5% are in government sectors, followed by private sectors (9.0%), own business (2.1%), and not working (0.9%). The second highest monthly income is income

| Categories                        | Female | Male | Total |
|-----------------------------------|--------|------|-------|
| Age (y.o)                         |        |      |       |
| 30–50 years old                   | 187    | 121  | 308   |
| 50–59 years old                   | 25     | 19   | 44    |
| 60 years old and above            | 2      | 9    | 11    |
| Below 29 years old                | 45     | 27   | 72    |
| Total                             | 259    | 176  | 435   |

| Occupation                        | Female | Male | Total |
|-----------------------------------|--------|------|-------|
| Government                        | 151    | 94   | 245   |
| Not working                       | 38     | 17   | 55    |
| Own business                      | 21     | 24   | 45    |
| Private                           | 49     | 41   | 90    |

| Categories                        | 30–50 (y.o) | 50–59 (y.o) | 60 (y.o) and above | Below 29 (y.o) | Total |
|-----------------------------------|-------------|-------------|--------------------|----------------|-------|
| Big city (e.g., Penang, KL, JB, Ipoh, Melaka, Seremban) | 149         | 15          | 5                  | 32             | 201   |
| City (e.g., Kuantan, KT, KB)      | 90          | 14          | 3                  | 22             | 129   |
| Village/rural area                | 37          | 6           | 1                  | 12             | 55    |
| Small town                        | 32          | 9           | 2                  | 6              | 50    |
| Total                             | 308         | 44          | 10.1               | 11             | 72    | 435   | 100.0 |
category RM 3001–5000 (27.6%), followed by income category RM 1001–3000 (24.4%). The percentages of these two income categories were mostly contributed by those who are working in government sectors, with 21.8% and 8.7%, respectively.

### 3.2.2 Section B: Targeted questions

Purchasing method preferences are among the key questions in the questionnaires. Based on the 435 respondents, the most preferred self-visit methods for marine fish supplies before the MCO is common “wet market,” with 316 respondents (72.6%) followed by “supermarket” with 259 individuals (59.5%), “grocery stores” (180 individuals; 41.4%), “night market” (107 individuals, 24.6%), “wholesale” (96 individuals; 22.1%), and finally “fish landing” with 47 individuals (10.8%) (Fig. 3). While the preferences of these active self-visit methods decreased during the MCO, the preferences for the other methods, which can be categorized as passive methods, increased during the MCO. The decreased preferences of active methods and the increased preferences of passive methods indicate that some of the respondents prevent themselves from going to crowded places to avoid getting infected by the COVID-19 virus. Nonetheless, most respondents will go back to their pre-MCO preferences and active methods. By comparing preferences between during MCO and post-MCO for both active and passive methods, active methods recorded increments (Fig. 3). On the other hand, passive methods recorded decrements, indicating that there is a high tendency for the respondents to go back to their original preferences after the MCO.

| Categories                | Below RM 1000 | RM 1001–3000 | RM 3001–5000 | RM 5001 and above | Grand total |
|---------------------------|---------------|---------------|---------------|-------------------|-------------|
| Government                | 1 (0.2%)      | 38 (8.7%)     | 95 (21.8%)    | 111 (25.5%)       | 245 (56.3%) |
| Not working               | 36 (8.3%)     | 11 (2.5%)     | 4 (0.9%)      | 4 (0.9a)          | 55 (12.6%)  |
| Own business              | 9 (2.1%)      | 25 (5.7%)     | 2 (0.5%)      | 9 (2.1%)          | 45 (10.3%)  |
| Private                   | – (0.0%)      | 32 (7.4%)     | 19 (4.4%)     | 39 (9.0%)         | 90 (20.7%)  |
| **Grand total**           | **46 (10.6%)**| **106 (24.4%)**| **120 (27.6%)**| **163 (37.5%)**   | **435 (100.0%)** |

*a* Probably the respondents referring to household income.
Fig. 3 Purchasing method preferences by the number of respondents in acquiring marine fish supplies pre-, during, and post-MCO due to COVID-19 pandemic (can choose more than one answer; Q8–Q10).

Fig. 4 Reasons for using an online method to get marine fish supplies during MCO (can choose more than one answer; Q11).

Fig. 4 shows that the main reason for the respondents using online platforms to get marine fish supplies during the MCO is to “avoid crowded places,” with 306 votes (70.3%). The second and the third greatest reasons are “easy, no need to go out,” with 292 votes (67.1%), followed by “to save time,” with 186 votes (42.8%), respectively. The other options are all fewer than 65 votes, or 15% out of 435 total respondents, which include “on-time delivery” (53 votes), “fresh supplies” (49 votes), “free delivery” (39 votes), and “lots of choices” (28 votes).

On the contrary, the main reason for not using online platforms to get marine fish supplies during the MCO is due to the “inability to choose” with 239 votes (55.0%) (Fig. 5). The second highest votes indicate respondents’ habit, which is “used to purchase directly from local market/supermarket/
“unavailability of online offer” received 120 votes (27.6%) and some did not use online platforms as their “purchase was lower than minimum order” (107 votes; 24.6%) (Fig. 5). Those who live near a fish landing site continued their direct purchasing method (28 votes; 6.4%). Other reasons include “the uncertainty on the quality” (i.e., freshness) of the marine supplies. In terms of quality or the freshness of marine fish supplies (Q13), 429 or 98% of the respondents agreed that it is one of the main factors when making a purchase.

The most important question in the questionnaire was respondents’ opinion on whether marine fish supplies had dwindled during the MCO (Q14), with 247 or 57.2% respondents voting “No,” whereas 185 (42.8%) respondents voted “Yes,” while 3 respondents did not vote. Based on the Chi-square test of independence, among all five demographic factors analyzed (age, gender, occupation, types of living area, and income), only gender $[\chi^2 (df = 1; n = 432) = 74.815]$ and types of living area $[\chi^2 (df = 3; n = 432) = 12.157]$ were significantly different ($P<0.05$), indicating that the ratios for Yes/No between male and females were different, demonstrating a dependency effect between Yes/No and gender. Fig. 6 shows that male respondents had more tendency to vote “No” compared to female respondents. Female respondents showed an almost similar percentage between Yes and No with 28.0% and 31.3%, respectively.
Fig. 7 shows respondents’ opinion whether marine fish supplies had dwindled during the MCO (Q14) by types of the living area since the Chi-square independence test indicated a significant result that means the Yes/No ratios among the types of living areas were different. According to this figure, most respondents at all types of living areas do not think there was a shortage of marine fish supplies except for those who are living in rural areas, since their vote for Yes was greater than the vote for No with 7.4% to 4.2%, respectively. Q15 is the second most important question in the questionnaire after Q14. Based on Fig. 8, 77.4% out of 256 respondents agreed that marine fish supplies mostly dwindled or were mostly affected in the first month of the MCO, which was between March 18 and April 14. The percentage decreased from 16.8% to 1.2%, from Week 3 onward, indicating the
recovery of marine fish supplies. Only 22.5% out of 178 respondents agreed that marine fish supplies are normal since the beginning of the MCO. Marine fish supplies showed an increasing trend from 18.5% to 67.4% from April 15 to June 9. Fig. 9 shows respondents’ frequency in acquiring marine fish supplies during MCO. Out of 432 respondents, 35.4% went out once a week, followed by “whenever necessary” and “every 3 days” with 30.3% and 14.8%, respectively. Percentages for the other answers are less than 7%. This result indicated that most respondents are aware of the risk of exposure and the contagious level of COVID-19 that they limit their frequency to purchase marine fish supplies.
4. Main discussion

Here, we provide meticulous survey observations as a basis for scientific theory on the impacts of COVID-19 and climate stress on the food chain sector, as well as the current systematic literature review on the research topics of COVID-19 and supply chain. Our study results showed the impacts of COVID-19, especially the movement control order on the seafood supply chain from a Malaysian perspective. To date, the hardest-hit Southeast Asian countries in terms of reported cumulative cases have been Indonesia and the Philippines (WHO, 2020). The geography of large coastal areas also makes Southeast Asia one of the most affected areas by food chains and COVID-19. Based on the literature of synthesis evidence, we found that Indonesia was the most affected country in terms of COVID-19’s impact on the Southeast Asia food supply chain.

4.1 Systematic review discussion

4.1.1 Discussion paper no. 1: COVID-19 impacts and adaptations in Asia and Africa’s aquatic food value chains

Belton et al. (2021) implemented a qualitative interview (phone survey through semistructured interview) as well as an online survey (social media platform) comprising two general sections of background of the respondents and types of business the actors operated. The survey was done during the active period of COVID-19 in most of the countries involved. Belton et al. found that the COVID-19 containment measures (lockdown, movement control order, border closure, etc.) impacted the food value chain such as access to buyers, transport, production inputs, employment, prices and traded quantities of aquatic foods, and inputs for aquatic food production. Additionally, the study also revealed that the demand for aquatic food has decreased and the prices of the manufactured fish feed have increased compared to the same periods last year.

4.1.2 Discussion paper 2: Utilization of data mining techniques in national food security during the Covid-19 pandemic in Indonesia

According to the study by Elsi et al. (2020), the COVID-19 pandemic in Indonesia has disrupted the availability of sufficient food in terms of quality and quantity (safe, diverse, nutritious, equitable, and affordable). They also
found that more than 40% of the total provinces are still under the lowest cluster of food security issues as well as fulfillment of higher food needs (19 total provinces). However, the lack of an online survey on the impacts of COVID-19 containment measurements has been noted for the issue of food supply chain management as they are used in the secondary data from the Indonesian Statistics Agency (BPS) for the issue of food access and availability.

4.1.3 Discussion paper 3: Utilizing social media technology during the COVID-19 pandemic to assist highly vulnerable populations in the Philippines

Go et al. (2020) found that Internet technology and social media platforms can be used as effective methods for responding to a range of disaster and crisis situations like the COVID-19 global pandemic. Access to healthcare, education, food, supplies, and livelihood affected the extreme low-income families through quarantine restrictions far from town centers.

4.1.4 Discussion paper 4: Application for providing the food menu based on available food raw materials, cost, and avoidance for certain diseases

Layona and Yulianto (2021) found that the web-based applications are beneficial for housewives’ daily food consumption, food supply, and availability of raw materials during the COVID-19 home confinement. The study used the quantitative methods and waterfall methods as one of their web-based application development. The results showed that the cost of cooking can be achieved through the application of the web-based strategy. A total of 90 selected housewives in Banten province, Indonesia participated in the collection of data and fulfillment of their cooking experience and expectation. They concluded that the application is interesting, easy to use, all features and information already meet their needs, user-friendly, and reduced their food consumption costs during the COVID-19 pandemic. They also suggest that the application should be developed in a mobile version in the future.

4.1.5 Discussion paper 5: Growing and eating food during the COVID-19 pandemic: Farmers’ perspectives on local food system resilience to shocks in Southern Africa and Indonesia

Paganini et al. (2020) showed how small-scale farmers responded to the COVID-19 crisis and their mitigation and adaptation strategies. Three
different main findings were found from this study: (i) farming activities were impacted by the COVID-19 prevention measures; (ii) farmers’ livelihood and communities level; and (iii) the perceived food fluctuation and changes in diet, food sources, and consumption patterns. Paganini et al. also produced descriptions of coping strategies that were developed by farmers themselves. In two of the Indonesian regions, Toraja and Java, COVID-19 impacted their marketing disruption least as farmers continued to sell their products to the local communities. Social restrictions and community health were the most frequent keywords mentioned during the survey in Java and Toraja provinces, Indonesia, respectively.

4.1.6 Discussion paper 6: COVID-19, agriculture, and food security in Indonesia

The review by Rozaki (2020) found that the agriculture in Indonesia is the most affected sector by the global COVID-19 pandemic because it will impact the food production system from the limitation of economic activities by the government. The author suggested a few emergency and long-term strategies such as controlling food prices and offering subsidies to the impacted farmers. Effectiveness in food supply chain and increasing the food diversification are two examples of long-term strategies to fight the COVID-19 pandemic in terms of food security issues.

4.1.7 Discussion paper 7: Impacts of the COVID-19 pandemic on ginger production: Supply chains, labor, and food security in Northeast Thailand

Wannaprasert and Choenkwan (2021) found that the lockdown periods during the COVID-19 pandemic had positive effects on ginger prices and production. The study revealed that ginger prices were higher compared to the same period last year as the world market demand increased due to the belief that ginger can be used as an important antioxidant to prevent COVID-19 infections. However, some farmers reduced their farm sizes because of the high price of the rhizome seed (ginger seed). In addition, because of the lockdown periods and transportation restrictions in Thailand, most of the skilled labor from Laos was not available to work at the farms, and decreased the availability of skilled labor.
4.1.8 Discussion paper 8: The change of fruit supply chain in response to COVID-19 pandemic in West Java, Indonesia (case study of Anto Wijaya Fruit)

A study by Widi et al. (2021) found that the mango fruit supply chain was impacted by the movement restriction and shorter operating time during the COVID-19 global pandemic. The cultivation activities until the distribution of the mango was done according to traditional methods, and no technologies were implemented between farmers and the distributor.

4.2 Survey discussion

The 2019 Coronavirus disease (COVID-19) was declared as a pandemic by the World Health Organization on March 12, 2020 (Ciotti et al., 2020). Its exceptional rate of spread and limited knowledge about its exact treatment while the death rate increased worldwide not only forced policy and decision makers to make risky decisions (Beaney et al., 2020) but also forced citizens to abide by the MCO to both avoid getting infected and most importantly stay alive. As of June 11, 2021, this deadly infectious disease had caused a total of 3768 deaths (0.58%) with 84 new death cases from 646,411 total confirmed cases in Malaysia (MKN Telegram; assessed on June 12, 2021). The highest number of new death cases was recorded on June 2, with 126 cases (Sulaiman, 2021).

The results of this survey indicated that the majority of the respondents do not think that marine fish supplies dwindled during the MCO (Fig. 7). However, the difference between “Yes” and “No” was only 62 individuals (14.4%). Between genders, most males voted “No” as the Yes/No ratio was 1:1.75 compared to females’ 1:11. The differences in these ratios could be due to one’s decision and perspective on whether they need to acquire fresh marine supplies or not. Although 98% of the respondents agreed that fresh quality is the most important criterion for purchasing marine supplies, their true ability to differentiate between fresh and frozen fishes cannot be determined at this stage and they could simply be mistaken.

As Malaysia has progressed toward developed country status as stated in Wawasan 2020 (Vision 2020) (https://www.pmo.gov.my/ms/wawasan-2020/; Accessed June 24, 2021), the retailing industry has evolved tremendously (Ogiemwonyi et al., 2020) in the past 30 years. Stores transformation to superstores (e.g., Parkson, Jusco (Aeon), etc.), the openings of hypermarkets (e.g., Makro, Carrefour, Tesco, Mydin, etc.), lots of malls (e.g.,
KIPMarts, etc.), and wholesalers throughout the country in the last three decades increased the options for Malaysians to get not only their home supplies and food, but also marine fish supplies. While grocery stores have limited space and acquire their marine fish supplies daily from wholesalers, larger companies such as superstores and hypermarkets may have a larger storage volume and a huge continuous logistics chain of contracted companies to secure their supplies (Ramayah, 2020).

According to Wel et al. (2012), there are seven determinants of retail selection that Malaysians consider in choosing retail stores: (1) store personnel and physical characteristics of the store; (2) advertising by the store; (3) store convenience and merchandise selection; (4) store location; (5) peer influence; (6) product variety and quality; and (7) services offered by the store. While the determinants of retail selection study were conducted long before the pandemic and it was found that there was a minimal health risk, no movement restrictions, and limitations, the determinants may have changed during the pandemic and the enforcement of the MCO.

In the first phase of the MCO, which was from March 18 to April 1, 2020, many Malaysians made panic purchases, although the Prime Minister and hypermarket owners addressed and advised the nation that daily and food supplies were sufficient (Kaur et al., 2020; Ramayah, 2020). This panic buying, which may be due to FOMO (fear of missing out) among Malaysians, led to long queues and empty shelves scenarios (Kaur et al., 2020). The fear of the pandemic, which led people to reduce their visit frequency (Fig. 9) and bulk purchase, may have prolonged this scenario. As a result, latecomers may think that food supplies including marine fish supplies are limited due to the pandemic and the MCO, when in reality, this could be due to prolonged panic and bulk purchasing.

On April 10, 2020, BHONLINE (2020) reported that the nation’s fish stock was sufficient and consistent that supplies over demands as stated by Deputy Minister II of Agriculture and Food Industry, Malaysia, Datuk Che Abdullah Mat Nawi. He also said that the then-current marine fish stock was worth 185,000 t/month compared to the then-current demand at 155,000 t/month. He also added that there should not be a shortage of supplies because approval had been given to all fishermen and the logistics chain to operate during the MCO. To make it easier for consumers, a total of 36 fishermen’s associations nationwide had conducted direct marketing to consumers.

There is no denying that the COVID-19 pandemic affected the entire world on a global scale. On a nationwide scale, the health risk carried by this pandemic has affected human behavior in many ways including social
interactions, education, economy, public health, etc. Due to health risks and subsequent enforcement actions to control and mitigate, many sectors were forced to turn to the online platform as the new norm (Zheng, 2020). Although online trading had been part of Malaysian culture, it had never been serious in fish supplies. While most common methods to acquire marine fish supplies showed decrement, online, phone calls, and face-to-face methods had an increment with online method championing at a 380% increase (Fig. 4). This trend indicates that most people are willing to change their preferred methods to prevent themselves from getting infected with the deadly virus (Fig. 5) besides abiding by the newly regulated and implemented SOPs.

5. Conclusion and recommendations

In conclusion, the systematic literature review shows that there are only eight articles from seven different journals in the form of quantitative studies available focused on the impact of COVID-19-related issues on Southeast Asia food supply chain management, as the data from June 2021. Interestingly, a total of five studies were conducted in Indonesia, while one was done in Myanmar, the Philippines, and Thailand. All studies agreed that the COVID-19-related issues such as lockdowns, social distancing, and movement restrictions as well as border closure impacted the food supply chain in terms of distribution and food availability.

Based on systematic review and survey results, we found that the pandemic has had a high impact on food security. There is a need to improve the food value chain effectiveness and efficiency in order to achieve sustainable livelihoods and well-being of the community. The most important mitigation measure that needs to be taken is the enhancement of the use of technology for each stage of food value chain systems. All five main components of the food supply chain—production, processing, distribution, marketing, and consumption—can be improved with better technology. In terms of production and processing, a study by Widi et al. (2021) showed the importance of improving the traditional way of agriculture and moving forward to new types of farming such as precision farming where most of the work can be done off site. Precision farming can mitigate the issues faced by Wannaprasert and Choenkwan (2021) where skilled labor cannot work at the farms due to the movement control order. Food distribution and marketing can be made more efficient by improving digital connectivity in Malaysia, especially in rural areas. A study by Go et al. (2020) and the survey result of this paper has proved that Internet technology and social media
platforms can be used as effective methods for responding to a range of disaster and crisis situations like the COVID-19 global pandemic. With better connection and good implementation of the Internet of Things (IoT), food security issues in the future can be mitigated more effectively.

Policy makers also can use this pandemic situation to teach the wider population of the importance of a healthy diet. Study by Layona and Yulianto (2021) showed the benefits of apps for food awareness help in household food consumption, food supply, and availability of raw materials during the COVID-19 home confinement. In conclusion, the research on the pandemics impact on food security in Malaysia is still not fully explored. Focusing on integrating new technology in the food security value chain will lead to higher accessibility to resources and information leading to positive perceptions and sense of security among Malaysians. Well-explained information through creative means (videos or photos) will be more accessible to the public than traditional handouts or talks. The more that communities understand, the more likely they will be to benefit from it.

Ultimately, humans are able to change their behavior during a stressful time especially when health and lives are at risk. They will do their best to keep themselves safe and able to survive during a pandemic. Currently, Malaysians are in their third lockdown and the MCO is in effect, and it has been more than a year. Malaysians have gone through festive seasons with new norms and there has been no shortage of food supplies even for marine fishes and there is no more panic buying or bulk purchasing. This pandemic is not just an eye-opening experience, but also a reminder to all of us for holistic preparation for the worst in the future.

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Appendix

Question to the respondents

Survey Title: Impacts of Covid-19 on Marine Fish Supplies

Objective: The objectives of this survey are to determine the effect of MCO toward fish supplies and the preferable sales methods by the public during MCO.
General

1. Specify your age:
   a. Below 29 y.o.
   b. 30–50 y.o.
   c. 50–59 y.o.
   d. 60 y.o. and above

2. Specify your gender:
   a. Male
   b. Female

3. Choose your state:
   a. Johor
   b. Kedah
   c. Kelantan
   d. Melaka
   e. Negeri Sembilan
   f. Pahang
   g. Perak
   h. Perlis
   i. Pulau Pinang
   j. Sabah
   k. Sarawak
   l. Selangor
   m. Terengganu
   n. WP Labuan
   o. WP Kuala Lumpur
   p. WP Putrajaya

4. Specify your district
   a. (Specify:)

5. Choose your residential area:
   a. Big city (e.g., Penang, KL, JB, Ipoh, Melaka, Seremban)
   b. City (e.g., Kuantan, KT, KB)
   c. Kampung
   d. Pekan

6. Choose your career sector:
   a. Government
   b. Own business
   c. Private
   d. Not working
7. Specify your average monthly income:
   a. Below RM 1000
   b. RM 1001–3000
   c. RM 3001–5000
   d. RM 5001 and above

Consumers

1. How did you get your marine fish supplies prior to MCO? (choose all related answers)
   a. Wholesale
   b. Common wet market
   c. Supermarket
   d. Night market
   e. Grocery stores
   f. House-to-house
   g. Fish landing sites
   h. Online (Internet-based: WhatsApp, Telegram, others)
   i. By phone

2. How did you get your marine fish supplies during MCO? (choose all related answers)
   a. Wholesale
   b. Common wet market
   c. Supermarket
   d. Night market
   e. Grocery stores
   f. House-to-house
   g. Fish landing sites
   h. Online (Internet-based: WhatsApp, Telegram, others)
   i. By phone

3. Which methods will you still be using after MCO to get your marine fish supplies? (choose all related answers)
   a. Wholesale
   b. Common wet market
   c. Supermarket
   d. Night market
   e. Grocery stores
   f. House-to-house
   g. Fish landing sites
   h. Online (Internet-based: WhatsApp, Telegram, others)
   i. By phone
4. What are your reasons for using online methods to get your marine fish supplies during MCO? (choose all related answers)
   a. Easy, no need to go out
   b. Fresh supplies
   c. Lots of choices
   d. Free delivery
   e. To avoid crowded areas
   f. To save time
   g. On-time delivery

5. What are your reasons for not using online methods to get your marine fish supplies during MCO?
   a. Unable to choose
   b. Expensive
   c. My purchase below minimum order
   d. No online offer
   e. Used to purchase directly from local market/supermarket/grocery stores
   f. Not much choice
   g. Paid delivery
   h. I live near fish landing area
   i. Others. Specify:

6. Is the freshness of the fish one of your main factors in purchasing marine fish supplies?
   a. Yes
   b. No

7. In your opinion, did marine fish supplies dwindle during MCO?
   a. No (Go to question #10)
   b. Yes (Please answer next questions)

8. During which MCO did marine fish supplies dwindle the most?
   a. MCO 1 (March 18 to March 31)
   b. MCO 2 (April 1 to April 14)
   c. MCO 3 (April 15 to April 28)
   d. MCO 4 (April 29 to May 12)
   e. CMCO (May 13 to June 9)

9. During which MCO did marine fish supplies return to normal?
   a. MCO 1 (March 18 to March 31)
   b. MCO 2 (April 1 to April 14)
   c. MCO 3 (April 15 to April 28)
   d. MCO 4 (April 29 to May 12)
   e. CMCO (May 13 to June 9)
10. How frequently did you receive your marine fish supplies during MCO/CMCO?
   a. Everyday
   b. Every 2 days
   c. Every 3 days
   d. Every 4 days
   e. Every 5 days
   f. Once a week
   g. Whenever necessary

Link: https://forms.gle/r2edeabu6cdYYEzUA
      https://forms.gle/g3t1s81AV1KbnkD76

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