Aquaculture Economics & Management

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/uaqm20

How Norwegian aquaculture firms across the value chain were affected by and responded to COVID-19

Jarle Aarstad, Stig-Erik Jakobsen, Arnt Fløysand & Olav Andreas Kvitastein

To cite this article: Jarle Aarstad, Stig-Erik Jakobsen, Arnt Fløysand & Olav Andreas Kvitastein (01 Sep 2023): How Norwegian aquaculture firms across the value chain were affected by and responded to COVID-19, Aquaculture Economics & Management, DOI: 10.1080/13657305.2023.2251920

To link to this article: https://doi.org/10.1080/13657305.2023.2251920

Published online: 01 Sep 2023.

AQUACULTURE ECONOMICS & MANAGEMENT
https://doi.org/10.1080/13657305.2023.2251920

Taylor & Francis
Taylor & Francis Group

REPORT

OPEN ACCESS Check for updates

How Norwegian aquaculture firms across the value chain were affected by and responded to COVID-19

Jarle Aarstad, Stig-Erik Jakobsen, Arnt Fløysand, and Olav Andreas Kvitastein

The Mohn Centre for Innovation and Regional Development, Western Norway University of Applied Sciences, Bergen, Norway

ABSTRACT

Previous research has shown that Norwegian aquaculture did not report being much affected by COVID-19 but had a strong response to the pandemic regarding cost reductions, market development, and business network development. In this study, we take a step further and investigate if COVID-19 affectedness and responsiveness were consistent across the aquaculture industry's value chain. Also, we investigate if aquaculture industry involvement explains how firms were affected by and responded to the pandemic. Reexamining survey data from Norway shows that the firms, independent of value chain position or industry involvement, were not hit particularly hard by COVID-19 compared to firms in the manufacturing industry as a reference group. In addition, we show that the response to the pandemic in terms of cost reductions, market development, and business network development was strong across the value chain – chiefly among firms involved in producing or selling sea products and providing equipment and consulting services – compared to firms in the manufacturing industry. Finally, the response to the pandemic was consistently strong, independent of industry involvement. We conclude that aquaculture firms, across the value chain and independent of industry involvement, had a strong positive response to COVID-19, albeit not much affected.

KEYWORDS

Aquaculture; affectedness; COVID-19; responsiveness

Introduction

COVID-19 had a negative effect on numerous firms across industries (e.g., Gu et al., 2020; Shen et al., 2020), but for many, it also induced them to respond to the pandemic by strengthening their emphasis on product and market development along with an increased focus on digitalization and internal communication structures (Guo et al., 2020; Abuhussein et al., 2023; Martinez et al., 2021). In the European Union aquaculture industry,

CONTACT Jarle Aarstad jarle.aarstad@hvl.no The Mohn Centre for Innovation and Regional Development, Western Norway University of Applied Sciences, Bergen, Norway.

Nielsen et al. (2023) showed that while the pandemic created challenges for some actors, it induced opportunities for others. A study from the Mekong Region found that the pandemic reduced the mobility of aquaculture farmers, disrupted their logistics, and reduced demand, but also showed that small farms were relatively limited affected (Lebel et al., 2021). Large farms, in contrast, were relatively likely to seek new markets and access credit during the crisis (ibid.). Anderson et al. (2023) showed that U.S. seafood imports increased in 2020 and 2021 with no large price movements, which the authors attributed to largely intact international value chains during the pandemic. Similarly, Schmitz and Nguyen (2022) discovered that, after an initial decline in shrimp production and consumption early in the pandemic, the volumes later increased to higher levels than before 2020. Studies from Norway found that the pandemic did not significantly affect salmon exports (Asche et al., 2022b; Straume et al., 2022) but altered trade patterns, inducing stronger responses in larger firms than in smaller ones (Straume et al., 2022).

Adding to this literature, Aarstad et al. (2022) recently showed that firms in the aquaculture industry had a strong response to COVID-19 in terms of cost reductions, market development, and business network development, although they were not particularly affected by the pandemic. In other words, they showed that aquaculture firms' strong response to COVID-19 was not triggered by being strongly affected. However, a limitation of their study is that it does not consider the aquaculture industry's value chain, which consists of actors involved in (1) production and sales of salmon and trout, (2) production and sales of other sea farming species, (3) supply of technological solutions including equipment and consulting services, and (4) supply of other products and services including feed production, fish health products, and transport services.

Thus, we do not know how aquaculture firms involved in these activities across the value chain consistently were affected by and responded to COVID-19. Nonetheless, we assume that resources and learning may have spilled over to different actors across the value chain, which may indicate a consistent pattern concerning firms' affectedness by and responsiveness to COVID-19. The study's major contribution is to shed light on this issue.

Moreover, we aim to study if firms with limited exposure to aquaculture have been affected by and responded to COVID-19 in a similar or deviating manner compared to those with strong exposure to the industry. Our primary motive for this second research topic is to illuminate if a proactive response to the pandemic among those firms strongly involved in the industry is also spilled over to those with less involvement. Hence, we assume that the response to the pandemic has been strongest among those with the strongest involvement in the industry due to strong pre-COVID performance, but we do not rule out that this effect has also spilled over to those less involved in the industry.

The studies to which we have referred, showing that perhaps the Norwegian aquaculture industry, in particular, has coped well with COVID-19, may contrast with others reporting that it experienced supply chain challenges (Lebel et al., 2021; Ahmed & Azra, 2022; Alam et al., 2022; Yuan et al., 2022; Jaikumar et al., 2023), and production and sales problems (Islam et al., 2021; Gosh et al., 2022; Huber & Lasner, 2022; Alam et al., 2023; Khan et al., 2023). A possible explanation for the discrepancy is that Norway is a globally leading salmon producer country (Garlock et al., 2020; Asche et al., 2022a; Naylor et al., 2023), with many exporters and large exports to more than 100 countries (Oglend & Straume, 2019; Straume et al., 2020; Oglend et al., 2022). Also, the industry in Norway is regarded as a leading actor in innovation, technology development, and logistics (Bergesen & Tveterås, 2019; Cojocaru et al., 2021; Afewerki et al., 2023). These capabilities likely capacitate robustness to external shocks, we argue. The Norwegian aquaculture industry furthermore had solid pre-pandemic revenues and growth (https://www.fiskeridir.no/English/Aquaculture/Statistics), and finally, it has strong historical roots with a strong brand in numerous markets. Hence, these resources may have enabled the industry to cope relatively well with the pandemic.

To study our research questions, we reanalyze survey data gathered by telephone interviews. Our primary interest is to study firms operating in and affiliated with the Norwegian aquaculture industry, and we use firms operating in the manufacturing industry as a reference group. Below, we address further details about the data, methods, and analyses.

Materials and methods

The data includes a survey of firms operating in the Norwegian aquaculture industry. Among the suppliers, we only included firms with 20 percent or more of their sales to the aquaculture industry. The aquaculture sector operates across and beyond formal industries as identified by Standard Industrial Classification (SIC) codes. Therefore, identifying relevant candidate firms for the survey was done in collaboration with a private research institute having close connections and strong knowledge of that particular industry. The number of aquaculture firms that responded to the survey, collected via telephone interviews by Ipsos, a professional market research and consulting firm, was 201. It represents a response rate of 15 percent.

In another survey, we included 200 firms operating in the manufacturing industry. The survey's response rate is 25 percent, and the data were collected via telephone interviews by the same consulting firm. Here, we used the Brønnøysund Register Center, "a government body under the [Norwegian] Ministry of Trade, Industry and Fisheries" (brreg.no/en/about-us-2/our-mission/), to identify manufacturing firms labeled by SIC codes 10–32 (for further details, see ssb.no/en/klass/klassifikasjoner/6).

Both surveys, gathered in early 2021, were used by Aarstad et al. (2022). Consistent with their study, we appended the surveys to include the firms operating in the manufacturing industry as a reference group to those operating in the aquaculture industry. We are not sure why the response rate was lower for the aquaculture industry than for the manufacturing industry, but a plausible explanation is that several aquaculture firms do not formally have employees, which likely puts much pressure on a limited number of people running the business.

To measure affectedness as a dependent variable, the surveys asked: "to what extent [is] COVID-19 … affecting your enterprise today concerning … " issues that we report in the upper part of Table 1. To measure COVID-19 responsiveness as another dependent variable, the lower part of Table 1 reflects issues from the surveys tapping into that topic. Each issue was measured on a five-point Likert scale varying between "to a very little extent" (1) and "to a very large extent" (5). We took the average of those reflecting affectedness and responsiveness, respectively, to measure each concept. Aarstad et al. (2022, p. 2) report further details, including factor analysis and reliability coefficients (for details concerning factor analysis and reliability, please see Afifi et al., 2020). Taken together, COVID-19 affectedness reflects the extent to which firms reduced profitability, liquidity, and whether they experienced more demanding sales or production processes. COVID-19 responsiveness reflects how firms developed new business networks, new distribution channels and markets, maintained existing business networks, and carried out cost reductions.

In the survey of the aquaculture firms, the respondents were asked to indicate activities the firm had been involved in the last year. The activities they could choose between are listed in Table 2 (our translation from Norwegian), and the respondents were allowed to indicate more than one positive response in the survey i.e., each firm could be involved in more than one activity. Next, we applied the social network program Ucinet 6.756 (Borgatti et al., 2002) to identify structurally equivalent blocks of overlapping activities using the CONCOR (convergence of iterated

Table 1. COVID-19 affectedness and responsiveness.

COVID-19 affectedness	Reduced profitabilityReduced liquidityMore demanding sales processesMore demanding production processes
COVID-19 responsiveness	Development of new networksDevelopment of new distribution channels and marketsMaintenance of existing networksCost reductions

Table 2. Results of block modeling.

Block 1	Production of salmon or trout.Production of eggs or smolt.Slaughter or processing of salmon/trout.Sales of salmon/trout.
Block 2	Production of other sea farming species than salmon or trout.
Block 3	Production and sales of equipment for the sea farming industryConsulting and/or research services aimed at the sea farming industry.
Block 4	Production of feed.Production and sales of fish health products or services (including production of cleaning fish).Transport services for the sea farming industry (well boats, etc.).

correlations) technique by Breiger et al. (1975). The four blocks we identified and grouped the firms into, reported in Table 2, explain 79.2 percent compared to the ten individual activities at the outset (i.e., we lose only a little more than 20 percent of information by reducing the number from ten individual activities to four grouped blocks of activities). The algorithm identifying the blocks informs about activities that firms most commonly combine. E.g., a firm involved in one particular activity in Block 1 is also relatively likely to be involved in one or more of the three other activities in the same block but relatively unlikely to be involved in activities in Blocks 2, 3, or 4. Taken together, the activities grouped into the four blocks indicate how aquaculture firms operate in different parts of the value chain. Broadly, they represent actors involved in the production and sales of salmon and trout (Block 1), production and sales of other sea farming species (Block 2), supply of technological solutions including equipment and consulting services (Block 3), and supply of other products and services including feed production, fish health products and transport services (Block 4).

Also, firms indicating activities reported in Block 3 and 4 could further indicate the amount of turnover from the sea farming activities, which we grouped into less than or equal to 50 percent or more than 50 percent.

We control for international engagements (if the firm the last year had exports or production or ownership abroad) modeled as a dummy variable; responding yes was coded one, and zero otherwise. We acknowledge that the way of modeling the concept is debatable, but having said that, it is a control variable, and omitting it in unreported models does not alter any substantial statistical conclusion except that the Aquaculture dummy becomes borderline significant instead of non-significant in Model 1, Table 4 (we report on the model shortly). In addition, we control for majority ownership regionally, nationally beyond the region, or internationally. Omitting this control variable in unreported models does not alter any statistical conclusion.

Aarstad et al. (2022), analyzing the same data, also controlled for firm size in employees (varying between 0 and 629) and innovation performance, but as these variables showed non-significant effects in all their models, we omitted them from this study. In addition, we omit the variables environmental and social sustainability as they are not of particular interest

Table 3. Descriptive statistics.

	Min.	Max.	Mean	Std. dev.	Numb. obs.
COVID-19 affectedness	1	5	2.65	1.12	401
COVID-19 responsiveness	1	5	2.50	.842	
Major ownership outside the region[a]	0	1	.095	.293	
Major ownership internationally[a]	0	1	.075	.263	
International engagements	0	1	.429	.496	
Aquaculture[b]	0	1	.501	.501	
Block 1[b]	0	1	.142	.350	
Block 2[b]	0	1	.062	.242	
Block 3[b]	0	1	.200	.400	
Block 4[b]	0	1	.097	.297	
Less than or equal to 50 percent[b]	0	1	.629	.484	318
More than 50 percent[b]	0	1	.079	.270	

[a]Default is major ownership locally or regionally.
[b]Default is the manufacturing industry.

Table 4. Analyzing what impacts COVID-19 affectedness.

	Model 1	Model 2	Model 3
Major ownership outside the region[a]	−.007	−.008	−.131
	(.191)	(.190)	(.218)
Major ownership internationally[a]	.256	.248	.204
	(.185)	(.183)	(.203)
International engagements	.262* [.116]	.278* [.123]	.220† [.100]
	(.115)	(.116)	(.128)
Aquaculture[b]	.171		
	(.112)		
Block 1[b]		.187	
		(.171)	
Block 2[b]		.315	
		(.257)	
Block 3[b]		.080	
		(.141)	
Block 4[b]		.229	
		(.202)	
Less than or equal to 50 percent[b]			−.064
			(.204)
More than 50 percent[b]			.176
			(.139)
R^2/Adj. R^2	.028/.018	.030/.013	.023/.001
F-value	3.12*	1.94†	1.57 n.s.
Max./avg. VIFs	1.07/1.04	1.17/1.08	1.10/1.07
Number of observations	401	401	318

Two-tailed tests of significance for regression coefficients and robust standard errors are in parentheses. Beta values for significant regressors are in brackets. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$. Intercepts omitted.
[a]Default is major ownership locally or regionally.
[b]Default is the manufacturing industry.

here. The following analyses use ordinary least square regressions with robust standard errors.

Results

Table 3 reports descriptive statistics, and Table 4, reporting ordinary least square (OLS) regressions with robust standard errors, shows that firms in the aquaculture industry have not been affected significantly more by

Table 5. Analyzing what impacts COVID-19 responsiveness.

	Model 1	Model 2	Model 3
Major ownership outside the region[a]	−.009	−.015	.065
	(.121)	(.124)	(.134)
Major ownership internationally[a]	.126	.133	.082
	(.179)	(.179)	(.202)
International engagements	.228** [.134]	.237** [.139]	.206* [.097]
	(.083)	(.084)	
Aquaculture[b]	.465*** [.276]		
	(.080)		
Block 1[b]		.531*** [.220]	
		(.106)	
Block 2[b]		.643*** [.185]	
		(.174)	
Block 3[b]		.440*** [.209]	
		(.098)	
Block 4[b]		.301* [.106]	
		(.123)	
Less than or equal to 50 percentb			.462** [.146]
			(.143)
More than 50 percent[b]			.393*** [.210]
			(.094)
R^2/Adj. R^2	.107/.098	.115/.099	.083/.068
F-value	12.2***	7.68***	6.85***
Max./avg. VIFs	1.07/1.04	1.17/1.08	1.10/1.07
Number of observations	401	401	318

Two-tailed tests of significance for regression coefficients and robust standard errors are in parentheses. Beta values for significant regressors are in brackets. $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. Intercepts omitted.
[a]Default is major ownership locally or regionally.
[b]Default is the manufacturing industry.

COVID-19 than firms in the manufacturing industry as a reference group (Model 1). In addition, we observe a consistent pattern across the value chain, i.e., aquaculture firms grouped in neither of the four blocks report having been affected significantly more than firms in the manufacturing industry (Model 2). Finally, we observe that industry involvement does not explain how much aquaculture firms have been affected by COVID-19 compared to firms in the manufacturing industry (Model 3).

Firms with international engagements have tended to be more affected by COVID-19 than those without. The reason is possibly increased difficulties in international logistics compared to national logistics. Variance inflation factors (VIFs) showing values close to one indicate that multicollinearity is not a problem in the analyses.

Table 5, also reporting OLS regressions, shows that firms in the aquaculture industry have had a significantly stronger response to COVID-19 than firms in the manufacturing industry as a reference group (Model 1). In addition, we observe a consistently strong response across the value chain (Model 2). I.e., firms grouped in all blocks, particularly Blocks 1–3 involving those in production or sales of sea products and providing equipment and consulting services, have had a stronger response to COVID-19 than firms in the manufacturing industry as a reference group. Finally, we observe a relatively strong response to COVID-19 independent of industry involvement (Model 3).

Firms with international engagements have responded more strongly to COVID-19 than those without, and the effect is significant across all three models in Table 5. The strong response is probably because they were relatively much affected by the pandemic (cf. Table 4). As the independent variables are the same in Table 4 as in the previous table, the VIFs are the same.

Discussion and conclusions

Examining Norwegian survey data, we show in this study that aquaculture firms, independent of value chain position or industry involvement, were not hit particularly hard by COVID-19 compared to firms operating in the manufacturing industry as a reference group. On the other hand, we show that the response to the pandemic was strong across the aquaculture value chain, particularly among firms involved in the production and sales of salmon and trout, the production and sales of other sea farming species, and the supply of technological solutions, including equipment and consulting services. Also, the response was consistently strong, independent of industry involvement. We conclude that aquaculture firms, across the value chain and independent of industry involvement, had a strong positive response to COVID-19, albeit not much affected. A possible explanation of why there are such consistent patterns may be that resources and learning have spilled over to different parts of actors that are more or less involved across the industry's value chain.

The COVID-19 pandemic is now, hopefully, history, but its occurrence illuminates the aquaculture industry's strong resistance and proactive response to the sudden and unexpected exogenous shock. Industry particularities may explain why aquaculture firms across the value chain were not hit particularly hard by the pandemic. E.g., its output is considered a non-discretional product, and the industry could switch distribution from the restaurant market to the existing private consumer market. However, the industry's ability to respond proactively across the value chain further indicates an innate ability to leverage its position and seize opportunities in the wake of what, for many industry actors in unison, was considered a negative effect on economic activity. A plausible explanation is that the industry, at the outset, had abundant resources in terms of competence, size, revenues, and growth to seize opportunities when the crisis hit. A second explanation is the industry's experience with previous and present challenges, e.g., escapes, sea lice, and price volatility. A third explanation can be the Norwegian aquaculture industry's strong historical roots in local and rural communities that are used to a challenging and shifting environment (Fløysand & Jakobsen, 2017). A final explanation may be that aquaculture industry investments are procyclical (Landazuri-Tveteraas et al., 2023). Accordingly, a limitation of our study is that we did not address why firms in the Norwegian aquaculture industry across the value chain had a strong proactive response to the pandemic, and we suggest future research to investigate this issue. Another limitation is that the response rate was lower for the aquaculture industry than for the manufacturing industry, and future research should address this issue and aim to gain as similar sample structures as possible.

Disclosure statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding

Norges Forskningsråd.

Data availability statement

Requests to access the raw data should be directed to the first author.

References

Aarstad, J., Jakobsen, S.-E., & Fløysand, A. (2022). Has firms' emphasis on environmental and social sustainability impacted how they have been affected by and responded to COVID-19? *Frontiers in Sustainability*, *3*(913337), 1–6. https://doi.org/10.3389/frsus.2022.913337

Abuhussein, T., Barham, H., & Al-Jaghoub, S. (2023). The effects of COVID-19 on small and medium-sized enterprises: Empirical evidence from Jordan. *Journal of Enterprising Communities: People and Places in the Global Economy*, *17*(2), 334–357. https://doi.org/10.1108/JEC-03-2021-0043

Afewerki, S., Asche, F., Misund, B., Thorvaldsen, T., & Tveteras, R. (2023). Innovation in the Norwegian aquaculture industry. *Reviews in Aquaculture*, *15*(2), 759–771. https://doi.org/10.1111/raq.12755

Afifi, A., May, S., Donatello, R., & Clark, V. A. (2020). *Practical multivariate analysis*. Routledge.

Ahmed, N., & Azra, M. N. (2022). Aquaculture production and value chains in the COVID-19 pandemic. *Current Environmental Health Reports*, *9*(3), 423–435. https://doi.org/10.1007/s40572-022-00364-6

Alam, G. M. M., Sarker, M. N. I., Gatto, M., Bhandari, H., & Naziri, D. (2022). Impacts of COVID-19 on the fisheries and aquaculture sector in developing countries and ways forward. *Sustainability*, *14*(3), 1071. https://doi.org/10.3390/su14031071

Alam, G. M. M., Sarker, M. N. I., Kamal, M. A. S., Khatun, M. N., & Bhandari, H. (2023). Impact of COVID-19 on smallholder aquaculture farmers and their response strategies: Empirical evidence from Bangladesh. *Sustainability*, *15*(3), 2638. https://doi.org/10.3390/su15032638

Anderson, J. L., Asche, F., Garlock, T., Hegde, S., Ropicki, A., & Straume, H.-M. (2023). Impacts of COVID-19 on U.S. seafood availability. *Journal of Agricultural & Food Industrial Organization*, *21*(1), 1–9. https://doi.org/10.1515/jafio-2022-0017

Asche, F., Eggert, H., Oglend, A., Roheim, C. A., & Smith, M. D. (2022a). Aquaculture: Externalities and policy options. *Review of Environmental Economics and Policy*, *16*(2), 282–305. https://doi.org/10.1086/721055

Asche, F., Straume, H.-M., Garlock, T., Johansen, U., Kvamsdal, S. F., Nygaard, R., Pincinato, R. B., & Tveteras, R. (2022b). Challenges and opportunities: Impacts of COVID-19 on Norwegian seafood exports. *Aquatic Living Resources*, *35*, 15. https://doi.org/10.1051/alr/2022017

Bergesen, O., & Tveterås, R. (2019). Innovation in seafood value chains: The case of Norway. *Aquaculture Economics & Management*, *23*(3), 292–320. https://doi.org/10.1080/13657305.2019.1632391

Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002). *Ucinet 6.756 for windows: Software for social network analysis*. Analytic Technologies.

Breiger, R., Boorman, S., & Arabie, P. (1975). An algorithm for clustering relational data, with applications to social network analysis and comparison with multi-dimensional scaling. *Journal of Mathematical Psychology*, *12*(3), 328–383. https://doi.org/10.1016/0022-2496(75)90028-0

Cojocaru, A. L., Iversen, A., & Tveterås, R. (2021). Differentiation in the Atlantic salmon industry: A synopsis. *Aquaculture Economics & Management*, *25*(2), 177–201. https://doi.org/10.1080/13657305.2020.1840664

Fløysand, A., & Jakobsen, S.-E. (2017). Industrial renewal: Narratives in play in the development of green technologies in the Norwegian salmon farming industry. *The Geographical Journal*, *183*(2), 140–151. https://doi.org/10.1111/geoj.12194

Garlock, T., Asche, F., Anderson, J., Bjørndal, T., Kumar, G., Lorenzen, K., Ropicki, A., Smith, M. D., & Tveterås, R. (2020). A global blue revolution: Aquaculture growth across regions, species, and countries. *Reviews in Fisheries Science & Aquaculture*, *28*(1), 107–116. https://doi.org/10.1080/23308249.2019.1678111

Gosh, K., Chowdhury, S., Acharjee, D. C., Abdullah-Al, M., & Ghosh, R. (2022). Assessing the economic impacts of COVID-19 on the aquaculture and fisheries sectors in relation to food security: A critical review. *Sustainability*, *14*(14), 8766. https://doi.org/10.3390/su14148766

Gu, X., Ying, S., Zhang, W., & Tao, Y. (2020). How do firms respond to COVID-19? First evidence from Suzhou, China. *Emerging Markets Finance and Trade*, *56*(10), 2181–2197. https://doi.org/10.1080/1540496X.2020.1789455

Guo, H., Yang, Z., Huang, R., & Guo, A. (2020). The digitalization and public crisis responses of small and medium enterprises: Implications from a COVID-19 survey. *Frontiers of Business Research in China*, *14*(1), 19. https://doi.org/10.1186/s11782-020-00087-1

Huber, L. M., & Lasner, T. (2022). German aquaculture under Covid-19-impacts of the pandemic on the sector during 2020. *Aquatic Living Resources*, *35*, 19. https://doi.org/10.1051/alr/2022019

Islam, M. M., Khan, M. I., & Barman, A. (2021). Impact of novel coronavirus pandemic on aquaculture and fisheries in developing countries and sustainable recovery plans: Case of Bangladesh. *Marine Policy*, *131*, 104611. https://doi.org/10.1016/j.marpol.2021.104611

Jaikumar, M., Ramadoss, D., Sreekanth, G. B., Smrithi, K., & Parihar, R. D. (2023). Regional impacts of COVID-19 pandemic on aquaculture and small-scale fisheries:

Insights and recovery strategies in India. *Aquaculture*, *570*, 739403. https://doi.org/10.1016/j.aquaculture.2023.739403

Khan, M. A., Hossain, M. E., Rahman, M. T., & Dey, M. M. (2023). COVID-19's effects and adaptation strategies in fisheries and aquaculture sector: An empirical evidence from Bangladesh. *Aquaculture (Amsterdam, Netherlands)*, *562*, 738822. https://doi.org/10.1016/j.aquaculture.2022.738822

Landazuri-Tveteraas, U., Misund, B., Tveterås, R., & Zhang, D. (2023). Determinants of investment behavior in Norwegian salmon aquaculture. *Aquaculture Economics & Management*, 1–19. https://doi.org/10.1080/13657305.2023.2208541

Lebel, L., Soe, K. M., Thanh Phuong, N., Navy, H., Phousavanh, P., Jutagate, T., Lebel, P., Pardthaisong, L., Akester, M., & Lebel, B. (2021). Impacts of the COVID-19 pandemic response on aquaculture farmers in five countries in the Mekong Region. *Aquaculture Economics & Management*, *25*(3), 298–319. https://doi.org/10.1080/13657305.2021.1946205

Martinez, G., Renukappa, S., & Suresh, S. (2021). Business model innovation in small enterprises from developing countries during COVID-19 outbreak: Exploring drivers and BMI outcomes. *International Journal of Business Environment*, *12*(4), 364–388. https://doi.org/10.1504/IJBE.2021.118554

Naylor, R., Fang, S., & Fanzo, J. (2023). A global view of aquaculture policy. *Food Policy*, *116*, 102422. https://doi.org/10.1016/j.foodpol.2023.102422

Nielsen, R., Villasante, S., Polanco, J. M. F., Guillen, J., Llorente Garcia, I., & Asche, F. (2023). The Covid-19 impacts on the European Union aquaculture sector. *Marine Policy*, *147*, 105361. https://doi.org/10.1016/j.marpol.2022.105361

Oglend, A., Asche, F., & Straume, H.-M. (2022). Estimating pricing rigidities in bilateral transactions markets. *American Journal of Agricultural Economics*, *104*(1), 209–227. https://doi.org/10.1111/ajae.12230

Oglend, A., & Straume, H.-M. (2019). Pricing efficiency across destination markets for Norwegian salmon exports. *Aquaculture Economics & Management*, *23*(2), 188–203. https://doi.org/10.1080/13657305.2018.1554722

Schmitz, A., & Nguyen, L. (2022). Seafood supply and demand disruptions: The Covid-19 pandemic and shrimp. *Aquaculture Economics & Management*, *26*(4), 359–383. https://doi.org/10.1080/13657305.2022.2038719

Shen, H., Fu, M., Pan, H., Yu, Z., & Chen, Y. (2020). The impact of the COVID-19 pandemic on firm performance. *Emerging Markets Finance and Trade*, *56*(10), 2213–2230. https://doi.org/10.1080/1540496X.2020.1785863

Straume, H.-M., Anderson, J. L., Asche, F., & Gaasland, I. (2020). Delivering the goods: The determinants of Norwegian seafood exports. *Marine Resource Economics*, *35*(1), 83–96. https://doi.org/10.1086/707067

Straume, H.-M., Asche, F., Oglend, A., Abrahamsen, E. B., Birkenbach, A. M., Langguth, J., Lanquepin, G., & Roll, K. H. (2022). Impacts of Covid-19 on Norwegian salmon exports: A firm-level analysis. *Aquaculture (Amsterdam, Netherlands)*, *561*, 738678. https://doi.org/10.1016/j.aquaculture.2022.738678

Yuan, Y., Miao, W. M., Yuan, X. H., Dai, Y. Y., Yuan, Y. M., & Gong, Y. C. (2022). The impact of COVID-19 on aquaculture in China and recommended strategies for mitigating the impact. *Journal of the World Aquaculture Society*, *53*(5), 933–947. https://doi.org/10.1111/jwas.12886