Report on Dialogue Session # 1 January 22, 2024

Joint OFI-SINTEF Canada-Norway Dialogues on Marine Aquaculture Hazards and Risk Assessment

Barbara Neis, Dialogue co-organizer from OFI/Memorial University opened and moderated session #1. She explained that the Joint OFI-SINTEF Norway-Canada Dialogues on Marine Aquaculture Hazards and Risk Assessment grew out of an ongoing collaboration between SINTEF and OFI Module M that began several years ago. The very fruitful formal collaboration is coming to an end and the overarching objective of the dialogue is to create an opportunity to present findings from this and other research on marine aquaculture hazards and risk assessment to a broad range of key aquaculture stakeholders and researchers in order to provide an opportunity for these stakeholders and researchers to comment on the research and findings. A related objective is to contribute to a discussion of future research needs and exchange opportunities. Ingunn Holmen brought greetings from SINTEF in Norway. Both thanked participants for joining the Dialogue.

The first presentation was by Charlie Mather, Professor of Geography at Memorial University in NL and one of the co-organizers of the Dialogue. The title of his presentation was: *What do we mean by risk*?

Charlie explained that risk is a complex idea or concept that has different meanings for different people. Given this, we thought it would be helpful to open the Dialogue with a discussion of those different meanings before beginning to explore the various dimensions of risk associated with marine aquaculture, including how the OFI-SINTEF collaboration has approached risk assessment and response in its work. In Charlie's case, his work on risk has grown out of work he and others have been engaged in on mass mortality events (MMEs) in salmon aquaculture including, in particular, how such MMEs might be a growing risk facing the sector. Some of that work will be presented by Gerald Singh in Dialogue Session #2 in February. Related to this work, the MME researchers began reading the literature on risk and disasters based on the thinking that large MMEs might be thought of as disasters, i.e. low risk but potentially high impact events within the sector. Based on that background research, Charlie outlined three key points about risk:

1. While risk is not new, **risks are changing and we are much more aware of risk as a factor in our lives**. Risks are changing, for example, in the scale of the threats we are dealing with. Whereas in the past, risk tended to be more delimited spatially, temporally or even socially, today some of the key risks confronting us are broader scale, more multi-faceted and open-ended (as in the case of climate change) than they were in the past. One of the consequences of this is that it is increasingly difficult to calculate, quantify or assess risks accurately. To illustrate, he pointed out that Ingunn Holmen and Trine Thorvaldsen and their colleagues at SINTEF have worked on risk in marine

aquaculture for several years now and their research gives us insight into the complexity of the risks facing the sector: they range from fish welfare and food safety, to escape prevention, to vessel design, changing local and regional environments and so on. Risks are also more likely to be human-induced and that means it doesn't make sense to treat risks as acts of God or nature gone wrong. Finally, perhaps because of these changes (which we know about through research and other processes, we are increasingly mobilizing infrastructures and systems to try and manage and contain risks and we will hear from experts in Norway and Canada as well as from participants, we hope about some ways this is happening and what we are learning.

2. Consistent with the idea that risk is not just 'out there' independent of what we are doing, there is a growing understanding that **risks can be 'manufactured' or even 'engineered'**. A key point here is that we need to pay attention to the role that we play in generating the risks and hazards that we face. A related point, some argue, is that systems that are not risk averse, but instead push environmental systems to states of higher risk, manufacture more risk in the process, as illustrated by the Deepwater Horizon Disaster in the oil industry in the Gulf of Mexico and ways intensive livestock production can enhance the risk of high impact, low probability disease outbreaks. These and other examples point to a paradox: as we learn more about production systems and risk mitigation, there is a tendency to push those systems to their environmental/operational limits. In essence, instead of risk diminishing with knowledge it actually tends to increase. This can happen even as expert-led institutions are created to protect us because these institutions and access to experts can enhance confidence in taking bigger risks.

3. **Risks, hazards and their related impacts have different consequences across different industries and groups**. One of the points we will hear through the dialogue is how from an occupational health and safety point of view, marine aquaculture entails many hazards and compared to other sectors has high rates of injuries and fatalities. This has been documented for Norway, Canada and other countries. It has also been shown that injury and fatality risk, like risk from disasters such as Hurricane Katrina in New Orleans, is higher in some places than in others, and affects some groups more than others. These differences in vulnerability need to be considered in risk assessments and in the design and evaluation of risk mitigation options.

Charlie's intent in raising these three points is to encourage participants to keep them in mind as we proceed through the Dialogue sessions and to reflect, based on our own experience and knowledge, whether and how they might resonate in the context of marine aquaculture today and into the future.

The second presentation was by Ingunn Holmen, Research Manager at SINTEF Ocean, Trondheim, Norway. The title of her presentation was: *Regulation and Implementation of Safety Management and Risk Assessments within Norwegian Fish Farm Companies*. Ingunn opened by providing a broad introduction to the aquaculture industry in Norway noting its wide distribution, that it has 10,000 employees, and that 163 fish farming companies produce very large volumes of almost exclusively salmon and trout. Most farms use open, floating and flexible net cages and each cage can hold up to 200,000 salmon. The aquaculture fleet is an important part of the fish farming industry in Norway and consists of workboats, which are used for daily maintenance operations, as well as specialized service vessels, wellboats and feed vessels. She commented that aquaculture in Norway has been profitable but not free of accidents for workers.

Ingunn noted that Norway wants to increase production but further expansion requires efficient risk and safety management including of salmon lice, preventing escapes and occupational health and safety, but there are some conflicts between these priorities. For instance, their research showed that some fish farm workers think that in practice production is prioritized over safety. These are loyal workers, they want the industry to be successful and this can affect OHS. In other research SINTEF Ocean researchers have looked at the five different risk dimensions in Norwegian fish farming including fish welfare (lice, etc.), material assets (wear and tear and weather), workers OHS (high injury risk), external environments (pollution, fish escapes) and food safety (chemical and disease treatment). A related paper developed a methodology for hazard identification encompassing these risk dimensions (Yange, Utne and Holmen 2020).

Ingunn showed a figure outlining the regulatory framework for Norwegian fish farming. She noted different regulatory agencies and laws are distributed across multiple acts. At the organizational level, she noted, the safety management system in fish farming involves multiple relevant actors. Measurement of safety performance levels includes systems for reporting on fish escapes, fish welfare indicators such as lice counts and parasites, occupational accident reporting to the Norwegian Labour Inspection Authority for occupational accidents and the Maritime Authority for vessel crews. There are also regulatory requirements for company internal measures including for reporting nonconformities or near misses, operating reports, days without accidents or incidents and weather forecasting and measurements of currents, waves, etc. SINTEF Ocean does research and produces reports on OHS in the sector. They have come up with recommendations for risk assessments within each fish farm or company, noting these should be performed with the fish farm operations as the starting point and should incorporate outputs from accident investigations. In terms of improving practice at the operational level, they believe implementing the recommended procedure for risk assessment can help to establish quality-assured procedures at fish farms and these can be used for training and decision support. Organizational and human factors influencing safety in operations also need to be included with attention to such things as work scheduling and the need to reduce work pressures. At the regulatory level, they think improvements can be achieved through the

development of a less fragmented set of regulations. Their research has shown management finds it challenging to report to multiple agencies and fragmented reporting could contribute to fragmented risk management systems. At present, she noted, there is a lack of coordination of regulatory inspections. Coordination would take effort but there is ongoing work to improve this situation. She noted the authorities could play a role in sharing best practices both for overall risk management systems and operational practices. The labour agency has decided to focus more on fish farms in an effort to reduce accidents. The Norwegian Directorate of Fisheries has initiated a new initiative for holistic risk management that may improve OHS as well as other risk dimensions.

Discussant Andrew Watterson, aquaculture OSH expert, University of Stirling, Scotland opened his comments by indicating the value of this Dialogue for not only participants from Norway and Canada but also for those from other countries where global fish farming companies operates. From this point of view, how Norway in particular tackles risk and risk assessments, including in health and safety, is globally relevant.

He thought Charlie's presentation set the scene nicely for the whole Dialogue with great relevance for today's session and for those in the future including on emergency preparedness, climate change and risk reduction strategies. The presentation raises important questions about hazard identification, risk definitions and response, and the role of institutions in manufacturing or engineering risk. His emphasis on variable vulnerabilities to risk and the related questions of who creates risks, who experiences risks, who assesses them and who controls them are all important and central to work on health and safety. The point about pushing risk boundaries is critical to the development of policy and practice.

Ingunn's presentation introduced the important in depth, evidence-based research on aspects of regulation and the implementation of safety management and risk assessment in Norwegian fish farm companies done through SINTEF in Norway. Norway has a very large aquaculture workforce that is four times the size of the Scottish workforce and the scale of its operations has, he thinks, influenced the significant investment of Norwegian resources into the field of aquaculture risk assessment and occupational health and safety (OHS). Ingunn describes the challenges planned expansion of Norwegian fish farming will bring and the tensions and possible conflicts that may emerge. Several of these challenges are and will occur in other countries, including Canada. They have led to doubts being raised about the future of 'luxury' salmon production and include threats to wild salmon, growing sea lice problems and fish welfare concerns.

Based on Ingunn's presentation, Andrew suggested, a key issue to explore in the Canadian context is the Norwegian view among owners, managers and workers that there is no serious conflict between production and safety in the industry. Is this due to good regulation, management, investment, staffing levels, reasonable work pressures or effective engagement of workers in addressing health and safety issues or a combination of all these things? Ingunn flags key issues in Norway concerning: a) the need to reduce work pressures and increase

worker involvement in safety decisions; b) how insurance pressures might affect risk assessments and occupational injuries and diseases; c) how effective inhouse measures will be in the future and how procedures can or should be standardized; and, d) whether holistic, coordinated regulatory visits will work or will dilute oversight, expertise and time available and possibly lack the focus and depth needed to continue to reduce injuries and disease in the sector. We could add, Andrew thought, will consumers be able to press effectively for better OHS in the industry?

Andrew noted there is a view in Europe that Norwegian OHS is generally better than it is in many other countries because of its social values and social cohesion, and because of structures that allow worker involvement in OHS decision-making. Does Canada have a similar approach to Norway and does it use the same regulatory and risk assessment tools and as effectively? If it doesn't, would it want to adopt them? (These are questions we can explore in Dialogue #4). Related to this, Andrew wonders if health and safety principles, structures and relevant templates should be transposed between countries where the industry may have different risks and different circumstances?

Darrell Green from the Newfoundland and Labrador Aquaculture Industries Association (NAIA) provided some opening stakeholder remarks to launch the discussion. He talked about the strengths of OHS in Newfoundland and Labrador (NL) aquaculture, noting they always have a session on OHS at their annual conference. He noted that, as with Norway, we have both a labour inspection agency and a marine authority. In NL the labour inspection agency is provincial and the maritime authority, Transport Canada is federal. He knows companies do risk assessments and not only meet but go above and beyond regulations and highlighted that in Canada, almost 100% of the salmon farming companies have BAP certification. As well as having an environmental component, BAP certification also includes a section on social responsibility and this includes 63 clauses with subsections on health and safety. BAP certification means they are in compliance with these clauses. He also noted BAP are rewriting standards on diver safety and that all of the clauses speak directly to risk reduction, risk assessment. The BAP standards include right to refuse dangerous activities, emergency protection plans, emergency response plans, OHS committees and one clause in particular is related to risk assessment. Clause 3.45 indicates the farm shall identify, prevent, eliminate and minimize any health and safety hazards through a risk assessment conducted at least annually and after each incident. He said there are only two companies in Canada that are not BAP certified. So he thinks the OHS systems in Canada and in NL, from what he has heard are really robust and really compliant.

Ingunn commented that, since he mentioned divers, that they are also important in Norwegian fish farming and are now part of service vessel teams. One or two divers with necessary certificates are employed on service vessels in Norway and there has been some discussion around who should be the responsible authority for diving- the maritime authority or labour inspection authority. That is not something they have looked closely at.

Darrell wondered about the push towards remote operation of sites in Norway. They are starting to get into that in NL; one of the companies has opened up an office for really remote sites. Based on his trips to Norway, he thought their sites were pretty safe but in some cases they might have to go through bad weather to reach really remote sites. He wondered if Norway has removed risk in transportation and noted the increasing role of AI in permitting remote monitoring of sites.

A second stakeholder reflected on the overall definition of risk noting how broad it is and how Ingunn narrowed it down to focus on regulations. In Canada, we have safety management plans and procedures for each of the companies that go into detail. We also have the same problem with regulations and overlapping jurisdictions in terms of who is regulating what. We have Transport Canada overseeing vessel safety, vessel design, inspection, and who can run the vessels. Every province is responsible for OHS on the vessel. This is very confusing for farm operators. They look at this internally and try to make sure they are following regulations to the best of their ability but it is a lot of work for the companies; it can be confusing in terms of which regulations they need to follow. Someone can correct him, but he doesn't think there are any standard risk assessment forms provided by any of these government agencies. The Department of Fisheries and Oceans provides most robust risk assessment support but it is mainly environmental and more focused on habitat, species at risk and cage siting versus operations. We do risk assessments every day and all the farmers do these on site but they are not necessarily formal. The most formal ones are for diving. They do look at the health and safety of employees and there are always frontline people on the committees. Fish escapes might be low risk on the environmental side but high risk on the social side, i.e. high risk for reputation loss.

Charlie responded to a question in the chat about defining risk that noted definitions of risk might vary between jurisdictions. In the case of mass mortality events, the sources of risk might be different so we need to pay attention to the geographical context. There are geographical aspects to risk.

Ingunn commented that it is very important to be very specific when you do risk assessments because the hazards will not be identical even between two farms in Norway. One location could be associated with strong currents, high waves whereas others could be at lower risk of these. There are also different probabilities for algal blooms.

Another stakeholder commented that in terms of algae blooms and risk, they had a recent presentation from the global director of ACFA insurance companies dealing with aquaculture. They indicated to us that a major impediment was how to provide information to insurance companies so they can adequately deal with risk and associated problems with getting insured and the high cost of insurance. Any comments about how you feed information on risk assessment to your insurance companies?

It was noted that models for sea surface temperatures, algae accounts, waves are more informed now they were in the past and they do make contingency plans with all of that information going back to insurance companies based on assessors who come to the farm and do this work.

Charlie commented that he thinks one of the lessons from the literature on risk is about the fact that it is increasingly difficult to predict all of the variables out there that might influence risk.

Andrew commented that much of the focus is on OHS management including injury risk assessment and around diving. Are there any insights around occupational disease and, to Ingunn, how do risk assessments translate from one country to another? Is there a lack of fit between what goes on in Norway and elsewhere within the same company? MOWI, a Norwegian fish farming company was responsible for the death of a worker in Scotland and the company was fined 800,000 pounds for a failure to make risk assessment, maintain systems of work, and provide employee with information. Why did that happen? This is a high risk area, injuries happen, there seem to be structural failures in the Norwegian approach.

Ingunn said the short answer would be there are the same kind of contributing causes to occupational injuries and fatalities in Norway as well. We do have the basic regulations and requirements but they have to be implemented, have to follow them and do all the mitigating and preventive actions that follow in order to reduce the risk associated with the identified hazard. Some say the problem is human error but they emphasize organizational training.

Another participant said he had to definitely agree with what was initially said about quantifying risk. When we quantify risk we have to be very specific about the location to which we are referring. Some of the studies in Canada used data from Norway and these might not be relevant. It is imperative that we always define the location when referring to quantifying risk. In terms of risk assessment and insurance companies, it would be useful to start a discussion data sharing. In his experience and from an academic point of view it is always very challenging when conducting research in Canada to get access to data. Most importantly and we might want to discuss this further either now or later is to talk about risk communication; about being clear what we mean when we quantify risk. We need to be very clear what we are doing, as researchers, when we quantify risk. Our objective is to improve practices, not bring down the industry. He did a study in BC in collaboration with industry at a time when the licensing of farms was a big issue and to his even though they had published research and it was available to the public it was not used in the hearings. Why would that be?

Charlie commented that these are important questions that should inform the dialogue as we move forward.

There was a question about OHS and corporate and individual responsibility. In Canada, there can be both corporate and/or personal responsibility for OHS, i.e. the individual supervisor can be charged. Is this the case in Norway and Scotland?

Ingunn indicated that in Norway, when it comes to occupational injuries or fatalities, it would be the company that would be held responsible, not individuals. However, in the case of an escape of farmed fish, individuals might be prosecuted. Andrew indicated that in Scotland the UK health and safety laws apply and OHS is the responsibility of the UK government but environmental issues are dealt with by the Scottish government. In the event of a safety failure, it could be the company or an employee who is held responsible. Regulators tend to go for the low hanging fruit and to go after the individual manager or employee rather than the company. That is because concept of the guiding hand. It is hard to prove the role of the guiding hand for the company and easier to prove it for someone further down the chain.

Charlie commented that based on his research he sees how important it is for the authorities to follow up on the regulations, but not an approach where they are just trying to find out what the industry is doing wrong, there should also be a dialogue there between authorities and industry. He thanked all the participants for a great session and reminded them of the next session coming up in February.