Open Ocean Salmon Farming in New Zealand

Review of possible options for Government support to assist with the establishment of a sustainable, inclusive, resilient, financially viable and rapidly growing open ocean salmon farming industry

]

Salmar ocean farm. Photo: Thor Nielsen, Innovation Norway.

"The salmon farming industry is capital-intensive and volatile. This is a result of a long production cycle, a fragmented industry, market conditions and a biological production process which is affected by many external factors"[1]

October 2021

[1] Salmon Farming Industry Handbook 2021: p58; MOWI 2021

Two Two Eight Limited
PO Box 8214
Havelock North 4157

Private & Confidential

Mat Bartholomew
Director Aquaculture
Fisheries New Zealand
PO Box 2526
Wellington 6140

20 October 2021

Open ocean salmon farming

Dear Mat

This report contains our review of the potential for development of open ocean salmon farming in New Zealand and the opportunities for the Government to provide support for the development. The challenge set for the aquaculture sector in the Government's 2019 Aquaculture Strategy and the Fit for a Better World roadmap to rapidly develop and grow revenue has been the catalyst for the review of the specific development potential of open ocean salmon farming and the options for Government assistance.

The report has been prepared in accordance with our contract with the Ministry for Primary Industries (MPI). Your attention is drawn to the important notice in Appendix C.

Information used to prepare the report has been sourced from publicly available reports and other documents and, importantly, provided by MPI and by parties interviewed for this report.

We acknowledge and thank the MPI staff who provided input and assistance and to the parties who agreed to be interviewed.

Please do not hesitate to contact me if you have any questions or require further information.

Thank you.

Yours sincerely

Bruce Wattie

Bruce Wattie
Director
Two Two Eight Limited

Contents

1. Executive Summary 1
   - Introduction 1
   - The aquaculture sector challenge 1
   - Open ocean farming 1
   - Resource consent processes, uncertainty and risk 2
   - Other obstacles to accelerated growth 2
   - Government intervention 3
     - Possible interventions 3
   - Concluding remarks 5
2. Introduction and background 7
   - Aquaculture in New Zealand 7
   - Purpose of this paper 7
   - The Government Aquaculture Strategy and the Roadmap 9
   - Industry exports 11
3. Industry value chain 15
4. Open ocean salmon farming in New Zealand 17
   - Introduction 17
   - Market considerations 17
   - Stage of development 18
   - Regulatory framework 18
   - Benefits to New Zealand 19
   - Industry scale 19
   - Māori economic development 20
   - Summary observations 21
5. Issues for industry viability and growth 22
   - Resource consenting 22
   - Iwi inclusiveness 23
     - Scale 23
     - Location 23
     - Skills and experience 24
     - Objectives 24
     - Nature of involvement 24
     - Contributions 24
     - Issues 24
   - Farming technical solutions (infrastructure and operations) 25
   - Research 25
   - Supporting infrastructure 26
   - Onshore facilities 26
   - Availability of labour and skills 28

Sustainability 28
Operating economics 29
Markets, pricing and demand for New Zealand King salmon 29
6. Financial analysis 31
7. Intervention 34
Introduction 34
Recommendations 35
Resource consenting 35
Interventions: 35
Issues: 36
Iwi participation 37
Objectives 37
Interventions 37
Issues 37
Research 38
Objective: 38
Interventions 38
Issues 38
Employing skilled migrants 38
Objective 38
Interventions 38
Issues 39
Skills development 39
Objective 39
Interventions 39
Issues 39
Onshore facilities 40
Objective 40
Interventions 40
Issues 41
Onshore infrastructure 42
Objectives 42
Interventions 42
Issues 43
Offshore farms 43
Objectives 43
Intervention 43
Issues 43
Market development 44
Objectives 44

Interventions 44
Issues 45
8. Evaluation of intervention options 48
Introduction 48
Observations 48
Evaluation tables 49
9. Delivery of Government intervention 56
Regulatory change 56
Enhancing knowledge and information 56
Direct investment 56
Principles for Government direct investment 57
Appendix A Land-based salmon farming 60
Appendix B Investment structures 62
Appendix C Important notice 63

Glossary

Term	Definition
CRIs	Crown Research Institutes
GHGs	Green house gases
IRR	Internal rate of return
MPI	Ministry for Primary Industries
New Zealand King salmon	Chinook salmon – Oncorhynchus tshawytscha
NIWA	National Institute of Water and Atmospheric Research Limitedn
RMA	Resource Management Act 1991
The Roadmap	Fit for a Better World, Accelerating our economic potential; Ministry for Primary Industries, New Zealand Government
The Settlement Act	Maori Commercial Aquaculture Claims Settlement Act 2004
The Strategy	Aquaculture Strategy; New Zealand Government
The UN	The United Nations

1. Executive Summary

Introduction

1. The consequences of COVID-19 for the New Zealand economy and society are many and varied. Actions taken by the Government to reduce the impact of the economic slow-down brought on by the pandemic and the policies implemented to minimise its health effects have to date been mostly effective and the Country's economy has proven to be more resilient than was expected early in the pandemic's onset. However, the appearance of the delta variant of the virus in the community has made the economic outlook in the near term less certain.

2. The Government has set an objective of enhancing the country's economic performance post COVID-19. It wants to not only regain ground lost because of the pandemic but achieve a step change to move above the growth trends the country was recording before COVID-19. The growth is to be achieved with greater inclusiveness so that all sectors of society share in the benefits and must be sustainable so that the four sources of capital that support wellbeing (natural, human, social and financial and physical[2]) are preserved if not enhanced.

3. The Ministry for Primary Industries (MPI) has identified that the primary sector can make a material contribution to achieving the Government's goal of a step change in economic potential through increasing the sector's productivity, sustainability, and inclusiveness. The plan for achieving the required gains from the sector is set out in the "Fit for a Better World" roadmap (the Roadmap).

The aquaculture sector challenge

4. The aquaculture sector is expected to make a material contribution to the goals for the wider primary sector set out in the Roadmap. To this end the Roadmap sets a challenge for the aquaculture sector to accelerate its rate of revenue growth and highlights areas the Government will focus on to support the sector to do so, including changing regulatory settings.

5. The Government's 2019 Aquaculture Strategy set a target of growing revenue generated by the aquaculture sector from the current level of approximately $650 million per annum to $3 billion by 2035. The challenge included in the Roadmap is for the sector to achieve $3 billion in annual revenue well ahead of 2035; 2030 is the new target date. Accelerating the sector's growth to reach the revenue objective early is presented as a transformational opportunity.

6. Commercial farming of mussels and oysters are successful industries and will be important to growing total sector revenue, as will new and emerging opportunities such as seaweed and farming fin fish other than salmon. But increasing salmon production and sales will likely provide a significant proportion of the revenue growth needed to meet the sector revenue target. MPI has estimated that salmon farming could generate $1.5 billion in revenue, almost all from exports, if production volume increases from the current level of approximately 15,000 tonnes to 70,000 – 80,0000 tonnes per annum, a five-fold increase.

Open ocean farming

7. While there might be opportunities to increase the productivity of existing salmon farms, the substantial increase in industry output to produce 70,000 – 80,000 tonnes of salmon per annum will require farming in the open ocean. Inshore water space with the right attributes and conditions for optimal salmon growth is limited. Moreover, environmental sustainability concerns, competition with other uses and values and rising sea temperature are making inshore farming challenging, particularly in the Marlborough Sounds.

8. Open ocean farming[3] is being used increasingly in Norway, the global leader in Atlantic salmon farming and trialled elsewhere, notably Chile, the second largest Atlantic salmon producer. Nevertheless, it is a relatively new method for farming salmon. There are no open ocean salmon farms in New Zealand yet and there is work to do to adapt the technology being used or developed in other countries to New Zealand open ocean conditions and to accommodate the differences in farming Atlantic salmon and Chinook salmon.

---

[2] https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework

[3] Defined as marine farming in open seas, which could be within the territorial sea, not exceeding 12 nautical miles from the coastline or in the exclusive economic zone, more than 12 nautical miles but not exceeding 200 nautical miles from the coastline.
Open ocean farming will likely require new technology and practices. This might involve adapting existing technologies or it might redefine aquaculture technology, including mobile aquaculture. Open ocean farming can be considered the "next generation" of marine farming.

9. *"..aquaculture production being able to take place in more exposed areas also entails new challenges relating to operations (including health, safety and environment), fish welfare and logistics."*[4]

10. The increase in industry production will not only require development of farms, but will require investment in onshore facilities, for example hatcheries and processing facilities. Also, market development will need to be ramped up to ensure that there will be demand for the growing volume at prices that will sustain the industry.

Resource consent processes, uncertainty and risk

11. We consulted a number parties are part of this study to obtain views and observations of the prospects of the industry being able to increase production to levels required to assist achievement of the Aquaculture Strategy's revenue target of $3 billion but earlier than 2035. We also asked for comment on what the Government could do to help the industry achieve the revenue objective – are there specific actions or interventions that will remove obstacles or barriers that will otherwise slow down industry development and growth?

12. A wide range of issues were identified by interviewees of varying importance and priority. However, there was an almost unanimous and strongly delivered message that the many uncertainties created by the regulatory environment, particularly the processes for securing and then operating within resource consents is the issue of most concern and that without change it will slow done or even impede rapid development of the industry.

13. The uncertainties include:

- Obtaining a resource consent: will a consent be issued, when and what conditions will be attached?
- Being able to modify operations in response to changing conditions, changing technology etc. without needing to seek a change to the consent or a new consent.
- Compliance monitoring.
- The likelihood of consent renewal.

14. For those who will be providing the substantial capital (equity or debt) the industry will need to develop open ocean farming value chains, uncertainty means risk. The greater the uncertainty and risk the higher the rate of return required to compensate for the risk. It will be difficult to raise all the capital needed to establish and grow operations over time if the return from open ocean salmon farming is not competitive.

15. Actions that can be taken to make a meaningful reduction in uncertainty will help make the industry a more competitive investment opportunity and provide a better environment for preparing and then executing plans for the many activities needed to establish and grow the industry. In short, if the Government was to do one thing to assist and promote industry growth then it should be to change the process for issuing resource consents to reduce uncertainty, cost, and time. The Government is aware of these issues and is actively developing and assessing options to improve regulatory settings.

Other obstacles to accelerated growth

16. Addressing concerns with the consenting processes will help the industry to grow at a faster pace than would otherwise be the case. However, there are a range of other matters that will need to be addressed before there will be confidence in the viability of large-scale open ocean salmon farming in New Zealand.

17. It is apparent from the consultation for this paper that there is a genuine intent from interested parties to push ahead with developing open ocean farms and the necessary components of the value chain, but the uncertainties and risks, aside from consenting, with what is a new technology for New Zealand will have a considerable impact on the pace of development. The development of farms and other components of the value chain will likely be on a time frame and on a scale initially that allow participants to manage risks prudently and enable development of technology and operating models that maximise value.

18. This suggests that if the Government changes the consenting process but does nothing else then the industry may well develop but at a pace that may not be sufficiently bold enough to reach total industry revenue of $1.5 billion within the time scale envisaged by the Roadmap. Moreover, the likelihood of deep and wide Māori/iwi involvement in the industry will be considerably less if there is no targeted Government support.

[4] Blue Ocean, Green Future, The Government's commitment to the ocean and ocean industries: P33; Ministry of Trade, Industry and Fisheries, the Government of Norway.

Government intervention

19. There are many possible interventions the Government could use to help the industry accelerate the pace of development. However, salmon farming in New Zealand and globally is a commercial business. It is an industry that ordinarily would not need Government intervention or assistance. Nevertheless, industry participants will likely accept Government support so long as it doesn't have too many strings attached that restricts their commercial freedom and doesn't create unequal opportunity among participants.

20. There are reasons for Government intervention other than accelerating the pace of development. Ensuring that industry growth is inclusive, sustainable, and resilient are all critical outcomes that the industry is expected to deliver. Achieving accelerated growth at the expense of these other outcomes will not be considered a success. The other outcomes are of no less priority than the rate of industry growth and should not be sacrificed to enable the industry to meet the Roadmap revenue challenge.

Possible interventions

Resource consenting

21. Feedback from applicants and others on the resource consent application process and outcomes was almost unanimous – it is fraught with risks and uncertainty that have real impacts on development timetables, costs and operating flexibility. These impacts are in addition to what many suggest are the high costs typically incurred to obtain a consent; costs that could be more productively spent on the work needed to prove viability in the case of open ocean farms.

22. There are four applications for open ocean salmon farms currently before the relevant authorities. These are the first applications for this form of salmon farming – no consents have been issued yet. Consequently, there is uncertainty about how the regulatory authorities will analyse these applications not least because the environmental impacts will be different to those of inshore farms.

23. The industry is of the view that making changes to resource consenting to reduce uncertainty of outcomes and speed up the process will be necessary prerequisites to rapid development of the open ocean farming. Officials are currently scoping possible changes, however it is not within the scope of this paper to provide detailed assessment of the resource consent issues and possible solutions. Nevertheless, some suggested options for how resource consenting open ocean salmon farms could be structured are included in this paper. These are in the form of concepts rather than detailed recommendations.

Facilitating iwi entry into the industry

24. Some iwi are actively pursuing an interest in open ocean salmon farming. Early engagement with other iwi by MPI has indicated that many are interested in exploring the opportunity. A factor that might influence which iwi will want to actively pursue the opportunity and in what form, is that that most suitable open ocean locations for farms will be off the east and south coasts of the South Island, which is in the rohe moana of Ngāi Tahu, and the onshore activities will likely be sited in the South Island to ensure cost effective links with the farms.

25. However, location of itself shouldn't be a barrier to iwi involvement and if there is interest, and it could be interest in not just farms but other parts of the value chain, then Government assistance to make this happen may be necessary. This assistance could provide a mechanism to discharge at least some of the Crown's obligation to deliver 20% of new water space, or equivalent value, to iwi under the Maori Commercial Aquaculture Claims Settlement Act 2004. It could also contribute to the broader Government objective to support Māori economic development by partnering with Māori to realise meaningful jobs, well-being, and prosperity.

Targeted research

26. The process for targeting research at solving the practical issues that need to be addressed to ensure that open ocean farming can produce high quality fish at scale and in a cost-effective manner needs refining. Interventions to achieve this should be lower in complexity than some of the other interventions and should be implementable in the near term, which is important as there is an immediate need for research to resolve early implementation challenges.

Access to specialist skills

27. Addressing shortages in specialist skills is an immediate issue. Allowing the industry to import the skills it needs to cost-effectively develop farms and operating models is theoretically straight forward but is practically challenging

given COVID-19. It may also be perceived as being inconsistent with the objective of enhancing local skills and employment opportunities.

28. However, the number of people with the requisite specialist skills needed by the industry is unlikely to be large but being able to being able to learn from their experiences and use their expertise will assist with increasing the pace of development and partially reducing the risk of development missteps. Also, it may help with training New Zealand personnel to enhance their skills and employment opportunities.

Availability of trained labour

29. The industry will need people with skills to work on farms and in the onshore activities. There is a shortage of skilled labour now. The shortage will become an increasing problem as the industry expands and if not addressed could be a constraint on growth.

30. Providing industry specific training to sufficient people will take time, so there is need to design and implement solutions as soon as possible. This will require intervention and is an area where Government and the industry could work together to develop solutions.

Market development

31. Market development activity will need to be ramped up over time to ensure that there will be demand for the growing volume at prices that will sustain the industry. There could be a role for the Government to assist with research into the likely level of demand for New Zealand King salmon in key markets, the potential for new markets to be developed and, importantly, the pricing dynamics in those markets. The objective would be to provide information that will assist existing and potential participants assess the likelihood of being able sell increasing volumes at the prices needed to ensure financial viability[5].

32. There could also be a role for the Government to support an industry approach to market development if the industry can agree to such an approach – it will not be fully effective if some choose not to participate.

Supporting infrastructure

33. The industry will require access to wharves, transport links, utility services and communication networks. Existing infrastructure may suffice but it will depend on where farms and onshore facilities are located and the state and capacity of the existing facilities. Financing any capital expenditure required to remediate, upgrade or construct new assets that might be considered public assets, such as wharves, roads and three water assets will need to be addressed, as will the timetable for undertaking any necessary work.

34. Government support to ensure that the necessary work is undertaken on a timely basis may be of assistance. This may not be straight forward as it will likely involve councils, who will own some of the infrastructure and deliver associated services and private sector parties, primarily in relation to telecommunications and energy networks and services.

Development of onshore facilities

35. Increasing industry production volumes to 70,000 to 80,000 tonnes per annum will not only require development of farms, but will require investment in onshore facilities, for example hatcheries and processing facilities. Individual participants will develop solutions for the onshore activities and services if it is financially viable to do so. However, whether this will be on a timetable that supports rapid growth is not certain. There could be role for the Government to assist with development of industry scale solutions earlier than individual participants might be prepared to do it they are left to develop their own value chains.

Development of offshore farms

36. The cost of the physical assets required for open ocean farm with the capacity to produce at least 10,000 tonnes per annum is currently estimated by MPI to be in the vicinity of $150 million. This includes pens and supporting assets such as vessels and barges.

[5] Financial viability is defined as generating sufficient free cash flow over time to repay the capital provided by both debt and equity investors and to pay them amounts at least equal to the rates of return they require on capital invested. Free cash flow is cash generated after payment of all operating costs, capital expenditure and any non-interest bearing liabilities due for payment.

37. This is a very significant investment. Investors will need confidence in the long term-financial viability of the industry before committing to provide capital at this level.

38. Research into farming methods, farm infrastructure and the interaction with the environment is being undertaken. However, completing research trials and undertaking market assessments to confirm that the increase in volume can be sold for prices that will support financial viability will take time.

39. Several of the interventions referred to earlier are directed at assisting with assuring viability, for example, the interventions to provide for focussed research and development and access to skills. There may also be a role for the Government to provide capital to assist with the financing and accelerate the development of farms at scale.

Concluding remarks

40. The long-term outlook for the New Zealand salmon industry is positive. New Zealand's successful inshore and freshwater salmon farming industry has done well to position New Zealand King salmon as a premium product in international markets.

41. Worldwide demand for premium seafood is high and expected to grow. The industry potential is underpinned by growing middle classes in developing nations driving increased demand for protein and heightened consumer awareness of the benefits of nutritious seafood that is sustainably and ethically produced.

42. There is considerable potential for the New Zealand aquaculture sector generally and for the salmon farming industry in particular, to grow and take advantage of the increasing demand for sustainably farmed seafood. Whether the growth can be such to achieve the revenue objective set out in the 2019 Aquaculture Strategy and the challenge included in the Roadmap is debateable. Perhaps these should be considered to be more in the nature of aspirations to spur growth than definitive expectations.

43. A step change (increase) in the amount of salmon to be produced will require farming in the open ocean. It will take time to establish this as a viable, scalable farming method. If there is a desire to accelerate industry growth, then Government intervention will be needed.

44. Changes to the consenting process to reduce the uncertainty, costs and time delays faced by applicants for resource consents is the most immediate and effective way the Government can support industry growth. Of the other possible interventions, facilitating iwi involvement in the industry, assisting the industry complete the research and science needed to ensure operational viability and sustainability, addressing the need for specialist skills and researching market demand and pricing dynamics will yield benefits in the near term and provide confidence to participants to move ahead with development at pace.

45. Interventions that will contribute to ensuring the supply of appropriately trained labour and assisting the industry with market development ahead of the increase in production will be important in the medium term as the industry moves beyond the establishment phase and production is ramped up. However, investors' confidence in the industry will be enhanced if there is some certainty at the outset that all resources needed to ensure long term financial viability will be available or in place when needed. It would be beneficial if the Government was able to signal the full package of interventions early albeit that some will not be needed initially. This will help with confidence, encourage commitment of capital and enable participants to plan with some certainty about how the Government will support the industry over time.

46. The rationale for any of the suggested interventions needs careful consideration. Salmon farming is a commercial business that would not be singled out for Government support in normal circumstances. Any public sector support must deliver appropriate public benefits. In this regard, Government assistance for industry growth must be achieved through sustainable practices and processes, provide meaningful opportunities for iwi and local communities to participate in and benefit from the growth and recognise the importance of resilience to long term viability. Intervening to spur growth but not at the same time incentivising sustainability, inclusiveness and resilience will not lead to optimal wider outcomes.

47. These wider outcomes are very important, not least because of the expectation that industry growth will contribute to enhancing national well-being. Also, salmon farming could be labelled as factory farming, which is coming under increasing scrutiny as consumers become more aware and concerned about the environmental and animal welfare impacts of different farming methods. Being able to demonstrate that the New Zealand salmon farming industry has sustainable and resilient operating practices and is expanding in a way that benefits as many sectors of society as possible would seem to be important to reassuring investors and other stakeholders that the risks and issues linked to

what is an intensive animal production method and the consequences for the broader food system are being effectively and appropriately managed in a way that will safeguard the long term financial viability of the industry.

48. The most appropriate mix of interventions should promote all the objectives that the Roadmap has set for industry growth and help lessen uncertainty and risk, so participants have confidence to invest and execute their development plans. Whether the pace of growth can be at the level needed to achieve the revenue challenge set in the Roadmap is not at all certain.

2. Introduction and background

Aquaculture in New Zealand

49. Aquaculture, for the purpose of this paper, is defined as the breeding, hatching, cultivating, rearing, or on-growing of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants for harvest. This requires human intervention to keep the "farmed" aquatic organisms distinguished or separated from naturally occurring aquatic organisms, among other things.[6]

50. Commercial aquaculture in New Zealand, being aquaculture activities undertaken by private sector businesses and organisations for the purpose of generating financial benefits for those that own or control the aquaculture activities, involves farming, processing and marketing and selling Greenshell™ mussels (*Perna canaliculus*), King salmon[7] (*Oncorhynchus tshawytscha*) and Pacific oysters (*Crassostrea gigas*).

51. There are no other marine species being farmed at scale in New Zealand yet[8], but there is research being undertaken on the technical feasibility of farming other marine animals and plants and developing production techniques. However, developing commercially viable businesses for these other species, assuming farming at scale is technically feasible and cost effective, is likely to be some way off.

Purpose of this paper

52. The Government's 2019 Aquaculture Strategy sets a target of growing annual revenue generated by the aquaculture industry to $3 billion by 2035. The $3 billion target is a significant increase over current industry revenue of $650 million per annum.[9]

53. The very considerable impact of COVID-19 on the New Zealand economy has prompted the Government to consider actions it could take[10] to enable the industry to grow faster than currently envisaged and achieve $3 billion in revenue earlier than the 2035 target[11]. This has been identified as a transformational opportunity.

54. The challenge to accelerate the industry's revenue growth has been made to provide support to the strategy the Government has formulated to enhance the country's economic performance post COVID-19. The objective is to not only regain ground lost because of the pandemic but achieve a step change to move above the growth trends the country was recording before COVID-19. The growth is to be achieved with greater inclusiveness so that all sectors of society share in the benefits and must be sustainable so that the four sources of capital that support wellbeing (natural, human, social and financial and physical) are preserved if not enhanced.

55. Increasing the productivity, sustainability and inclusiveness of the primary sector is expected to provide a material contribution to achieving the goal of a step change in economic potential. The plan for achieving the required gains from the sector is set out in the Government's "Fit for a Better World" road map (the Roadmap).

56. Aquaculture is an important part of the Roadmap and the industry achieving a higher growth rate is critical to the contribution the primary sector is expected to make to the step change in the country's economic performance.

---

[6] This definition combines definitions of aquaculture, aquaculture activities and marine farming contained in the Resource Management Act 1991, the Commodity Levies (Mussel, Oyster, and Salmon) Order 2007 and the Fisheries Act 1983. It also draws on a definition of aquaculture used by The Food and Agriculture Organization of the United Nations. Its definition of aquaculture is "… *the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture, while aquatic organisms which are exploitable by the public as a common property resources, with or without appropriate licences, are the harvest of fisheries.*"

[7] Also known as Chinook salmon.

[8] Moana New Zealand has an abalone farm in Northland with the capacity to produce 120 tonnes per annum. This is sold live and frozen direct to a range of international markets.

[9] Revenue generated from export and domestic sales of mussels, oysters and salmon.

[10] These include improving regulatory settings and investment certainty, investing in critical wharf and hatchery infrastructure and unlocking open ocean aquaculture opportunities.

[11] Fit for a Better World, Accelerating our economic potential: p10; Ministry for Primary Industries, New Zealand Government.

57. The $2.35 billion increase from current revenue of $650 million to achieve the $3 billion revenue target will need to be generated almost entirely from export sales. Approximately $450 million of revenue in 2020 was earned from exports of mussels, salmon, and oysters. The balance, $200 million, is earned from domestic (New Zealand) sales. Growth in demand for seafood by New Zealand's population of 5.1 million will make little impact on the $2.35 billion increase.

58. Commercial farming of mussels and oysters are successful industries and will be important to the aquaculture growth strategy, as will new and emerging opportunities such as seaweed and farming fin fish other than salmon. But increasing salmon production and sales will likely provide a significant portion of the revenue growth needed to meet the industry revenue target. Current estimates are that this will require annual production of salmon to increase from the current volume of approximately 15,000 tonnes to 70,000 – 80,000 tonnes, a five-fold increase in nine years.

59. Inshore water space with the right attributes and conditions for optimal salmon growth is limited. Moreover, environmental sustainability concerns, competition with other uses and values and rising sea temperature are having an impact on existing inshore farms and will make the expansion of inshore farming challenging, particularly in the Marlborough Sounds.

60. An alternative or alternatives to inshore farming will need to be found. This will include either open ocean farming and/or land-based farming (they are not mutually exclusive). These two farming methods are discussed later in this paper but, in short:

- Land-based farming of salmon to full sale weight is not an established farming method and is not proven to be financially viable anywhere in the world yet. It is a start-up technology. There has been growing interest in farming Atlantic salmon onshore in the northern hemisphere and several businesses have raised capital to fund developments. However, it is early-stage technology and still holds some substantial risks. Several companies pioneering the technology have recently suffered share price declines as investors have become more conscious and wary of the risks involved and concerned about achieving financial viability in a reasonable time frame.

  Land based farming may not be major contributor to the growth in New Zealand salmon production in the short to medium-term. However, it should not be dismissed as an option to compliment open ocean farming in the future if the technology is proven to be financially viable. It could also be a competitive threat, which is even more reason to keep abreast of developments in the technology other countries. Appendix A contains a more detailed discussion on land-based salmon farming.

- Open ocean farming is being used increasingly in Norway, the global leader in Atlantic salmon farming and trialled elsewhere, notably Chile, the second largest Atlantic salmon producer. Nevertheless, it is a relatively new production method. There are no open ocean salmon farms in New Zealand yet and more work is needed to successfully adapt the technology being used or developed in other countries to New Zealand open ocean conditions and to accommodate the differences in farming Atlantic salmon and New Zealand King salmon[12].

61. The focus of this paper is on the issues that will have to be addressed to establish a financially viable, sustainable, inclusive and resilient open ocean salmon farming industry in New Zealand at the scale needed to support the $3 billion revenue objective.

62. New Zealand already has a successful inshore and freshwater salmon farming industry, which has developed methods and operating models for growing high quality fish and has established New Zealand salmon as a premium product in international markets. Open ocean salmon farming will benefit from the success of the inshore and freshwater industry.

63. However, farming in the open ocean will require different infrastructure to that used for inshore farms and there will be changes to farming methods and operations. Participants will be able to draw on the somewhat limited experience of open ocean salmon farming in other countries, but weather and sea conditions off the east and south coasts of the South Island, the area with conditions most suitable for salmon, will be different to those off the coasts of Norway and Chile. The technology used in those countries will need to be adapted to work in New Zealand conditions. Similarly, the biological differences between New Zealand and Atlantic salmon mean that some elements of open the

[12] Chinook salmon take approximately 18-24mths in seawater to reach market size of 3-4kg. Atlantic salmon can grow at faster rates, although this is dependent on water temperature. Chinook salmon food conversion rates (FCRs) commonly range from 1.2 – 1.8. This is higher than the typical FCR for Atlantic salmon (0.9 – 1.2) (http://www.lbaaf.co.nz/nz-aquaculture-species/modelled-species/salmon/)

ocean farming methods being developed in Norway and Chile will not necessarily be directly applicable here. Also, the farming models and methods for inshore farming will likely require some modifications to accommodate the different conditions that will be experienced in the open ocean.

64. In short, research trials are being undertaken to support development of open ocean farming and the parties that have lodged applications for consents for open ocean salmon farms have made considerable progress in developing the technology solutions for their farms. However, more research and development will be needed to confirm the range of infrastructure technologies and operating methods that will work best for farming New Zealand King salmon in New Zealand open ocean conditions at scale. There will also need to be market research and development to stimulate demand so that markets can absorb the considerable increase in production required by the Roadmap at the prices needed for the industry to be viable.

65. Feedback from parties that have an interest in open ocean farming suggest that there is genuine enthusiasm to develop the industry. But issues with obtaining consents and operating within consent conditions and that the financial viability of sustainable open ocean salmon farming in New Zealand is not yet proven, mean that development of the industry will be undertaken at a pace that recognises that it is currently a commercially risky proposition. It is likely that this pace of development will not result in the growth in output needed for the 2030 objective. Moreover, it is not at all certain that it will enable a deep and wide Māori involvement in the industry.

66. The development of the industry could be accelerated if the Government provides assistance, either passively or actively to help the industry grow successfully within the time frame needed to achieve the $3 billion revenue before by 2030 objective. There are several options for the form and nature of this assistance. The options are explored and analysed in this paper.

The Government Aquaculture Strategy and the Roadmap

67. Growing revenue from aquaculture to $3 billion by 2035 as set out in the 2019 Aquaculture Strategy is challenging enough. Accelerating the growth, as set in the Roadmap is even more aspirational. However, the Strategy notes that:

- Worldwide demand for premium seafood is high and expected to grow. The growth potential is underpinned by the global population continuing to grow and, importantly, increasing wealth, particularly among the growing middle class in Asia, which is expected to be an important driver of demand for protein.
- Heightened consumer awareness about the benefits of healthy and nutritious food and the adverse environmental impact of some food production methods is resulting in increasing demand for sustainably and ethically produced seafood.
- Most of the world's wild capture fisheries are at or near capacity. Aquaculture is the proven way to increase sustainable seafood production within the earth's environmental limits.

68. COVID-19 aside, the positive outlook for aquaculture is a common theme in international literature. For example, Mowi ASA, the world's largest producer of farmed (Atlantic) salmon, notes that demand for salmon has exceeded demand in the last ten years and is forecasting that this imbalance between demand and supply will continue for the next five years[13].

69. While there are economic drivers for industry optimism – growing world population, growing middle classes and increasing urbanisation – aquaculture is well positioned to benefit from consumers increasing awareness of the need for more sustainable methods for producing protein to satisfy demand for nutritious and healthy foods and reducing exploitation of natural resources (e.g., wild fish stocks).

> "*An incredible 17% of the protein people eat already comes from the sea, but demand is set to rise by 40% by 2050. If this happens, we will need a sustainable, reliable protein source for the planet."*[14]
>
> *"It is widely acknowledged that global ageing populations, increases in income and wealth, healthier diets, and population growth are all leading to increased consumption of seafood. The inability to extract more seafood from the oceans has, and will, drive the need for increases in aquaculture production. Aquaculture, or farmed*

[13] Capital Markets Day 202: P14; Mowi. 17 March 2021.

[14] https://salmon.fromnorway.com/sustainable-aquaculture/future-prospects/.

seafood, has great potential in helping meet growing demand while protecting wild fish stocks, and at the same offering a healthy and eco-efficient protein source."[15]

70. The sustainability driver is very positive for the New Zealand aquaculture industry, which produces high quality farmed seafood with considerable nutritional benefits. These attributes combined with a focus on sustainable farming practices and processing operations provides the opportunity for the industry to expand significantly to meet growing demand from Asia and elsewhere.

71. There is a downside to sustainability concerns as in some countries it is being accompanied by efforts to promote "buy local" to capitalise on the perceived environmental and economic benefits of supporting local industries. The need for New Zealand food producers to overcome the handicap of being a long way from major consumer markets is nothing new but the need to convince consumers that they are not materially compromising their environmental principles by purchasing product that has been transported thousands of kilometres is an important marketing consideration for the entire New Zealand primary industry.

72. A very significant increase in production capacity will be needed to deliver annual revenue of $3 billion. The Strategy identifies that increased production across all species could be achieved through:

- Maximising the value of existing farms through innovation.
- Extending into high value land-based aquaculture.
- Extending aquaculture into the open ocean.

73. The Strategy is quite clear that increased production should not be unconstrained. It must be sustainable, inclusive and resilient.

74. Sustainability is to include operating in a manner that:

- Is consistent with transitioning to a low emissions economy.[16]
- Will ensure a healthy aquatic environment – both onshore and offshore.

75. Inclusiveness has several aspects to it, including:

- Employing more New Zealanders from all walks of life.
- Partnering with Māori and communities on opportunities to realise meaningful jobs, wellbeing, and prosperity.
- Building Māori and community knowledge about aquaculture and their input into growth opportunities.
- Delivering the Crown's aquaculture settlement obligations in a manner that facilitates early investment in new opportunities.
- Recognising Māori values and aspirations.
- Realising growth opportunities for regional economies, particularly regions that are most challenged by low employment and incomes.

76. It is unlikely that the amount of inshore water space dedicated to aquaculture can be increased to the level needed to achieve the $3 billion revenue by 2030 objective. Concerns about environmental degradation from fish (salmon) farming and competing demands for access to and use of inshore waters will constrain the expansion of inshore farming. Climate change impacts resulting in warmer ocean temperatures may necessitate moving production to cooler, deeper water.

77. The growth required by the Roadmap is expected to be generated through three key areas:

1. Maximising the value of the existing industry (Greenshell™ mussels, inshore salmon farming and pacific oysters) – up to $1.0 billion to $1.5 billion in additional growth;

[15] https://globalsalmoninitiative.org/en/our-work/the-future-of-aquaculture/.

[16] Including the objective of reducing biogenic methane to 24–47 percent below 2017 levels by 2050, including to 10 percent below 2017 levels by 2030. Climate Change Response (Zero Carbon) Amendment Act 2019: Part 1B Emission reduction Subpart 1—2050 target.

2. Development of open ocean aquaculture at scale, particularly for salmon farming in the South Island - $1.5b growth; and

3. Extension of aquaculture into emerging "blue sky" opportunities, such as products derived from farming seaweed – unknown growth. This may not contribute much to revenue in the next eight years or so (through to 2030) as the opportunities are at the early stages of research and development but they may well have considerable long-term potential.

78. This paper focuses on open ocean salmon farming. However, some of the suggestions of how the Government could assist or support the development of the open ocean salmon farming industry could apply equally to other industries within the aquaculture sector.

Industry exports

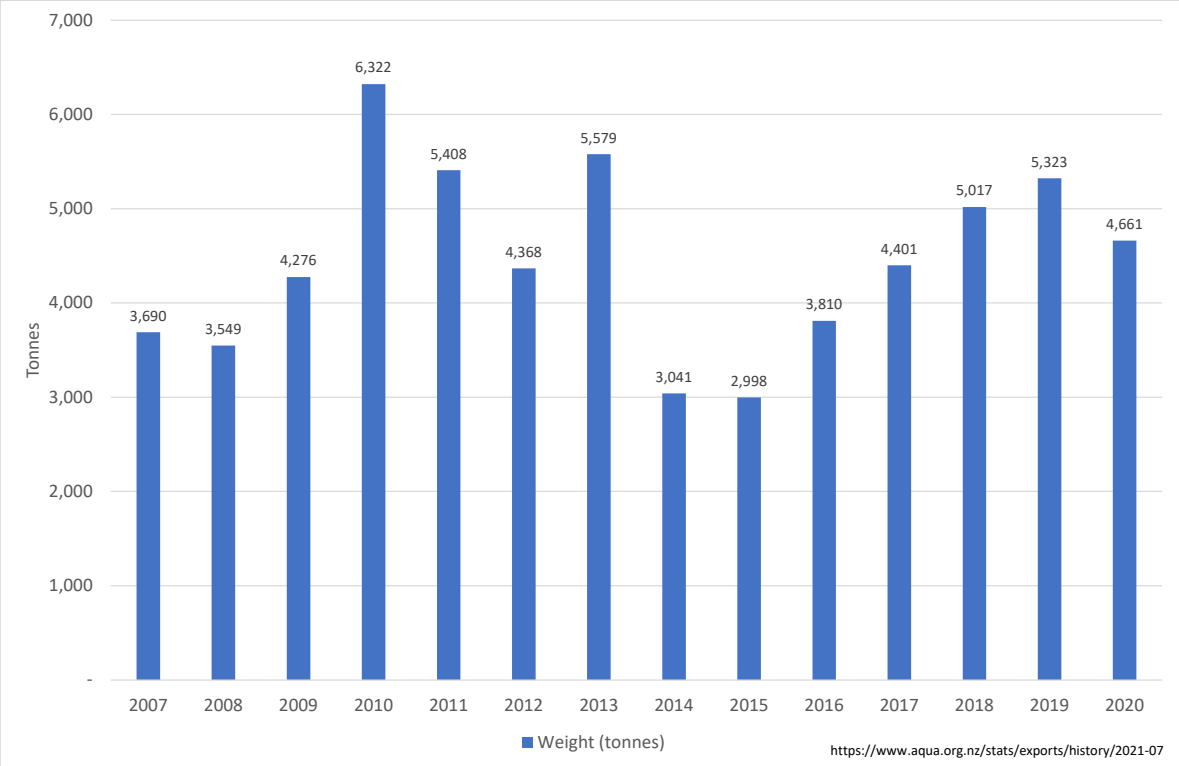
79. The following two figures show historical export volumes and values. This demonstrates some year-on-year volatility in export volumes.

80. Warmer water temperatures in the Marlborough sounds contributed to the reduction in volume in 2014. But perhaps more important were "*changes in fish husbandry to lower density…"*[17]. This change helped to reduce mortality and improved the quality of the fish but resulted in lower output volumes

81. Although volumes have been growing since 2014, the overriding conclusion from Figure 1 is that there has been no sustained growth in volumes over the period 2007 to 2020.

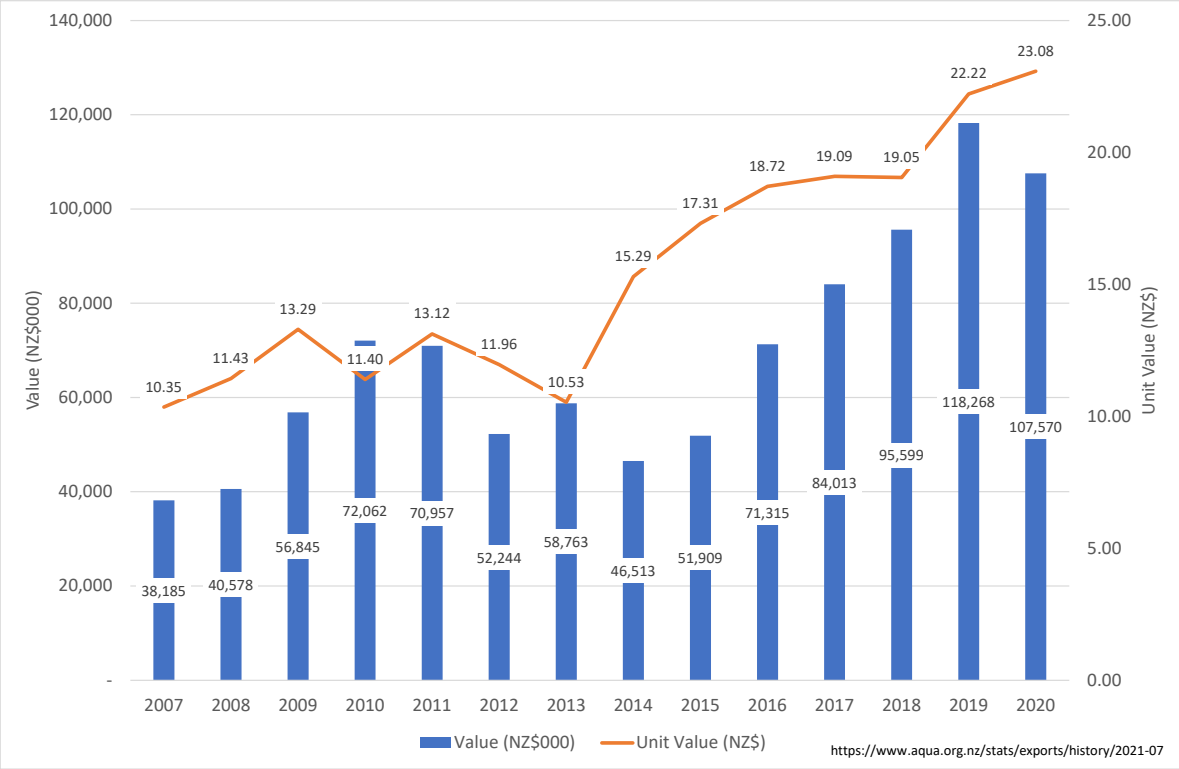
82. Prices show a much more encouraging trend, with considerable growth since 2007.

Figure 1 Export volumes



[17] The economic contribution of marine farming in the Marlborough region. A Computable General Equilibrium (CGE) analysis: P 9; New Zealand Institute of Economic Research. September 2015

Figure 2 Export values



83. Figure 3 and Figure 4 show export sales by country. The information is presented for the top five export markets (USA, Japan, Australia, Canada and China).

84. Figure 3 shows export sales (volume) for each of the top five markets as a percentage of total export sales volumes. Points to note are:

- The considerable growth in sales to the USA and the decline in sales to Japan. The information in Figure 4 shows that sales in the USA yield a higher revenue per kilo than sales in Japan.
- There has been a modest decline in the proportion of total export sales to Australia.
- China is a growing but currently small market. Total volume sales in 2020 and 2021 were 275 and 310 tonnes respectively. This compares to 3,270 and 2,680 tonnes exported to the USA in 2020 and 2021 respectively.
- New Zealand salmon was exported to 39 countries in 2021. The average sales volume to the next five largest markets (by sales volume) after the five markets included individually in the analysis, was 104 tonnes. The average volume for the remaining 29 countries was 4.6 tonnes.

85. Average export sales revenue for the top five markets is presented Figure 4.

Figure 3 Percentage of total export volumes by country (top five countries by volume)

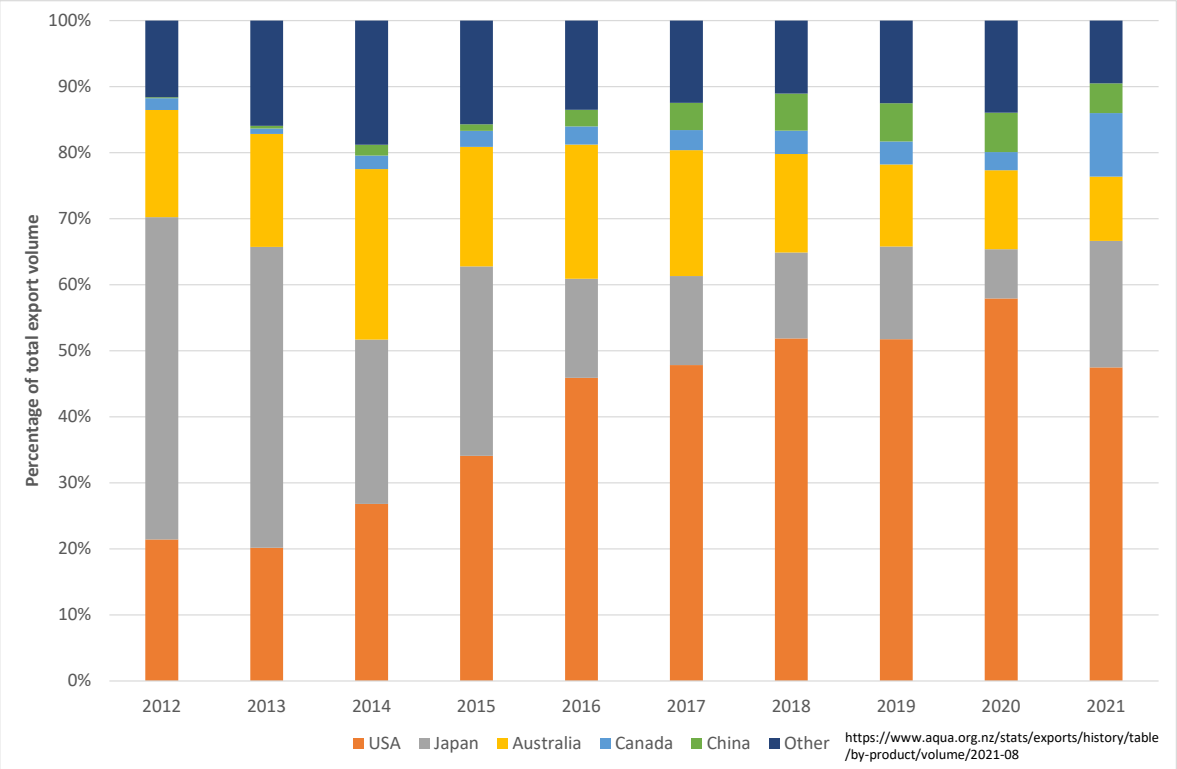
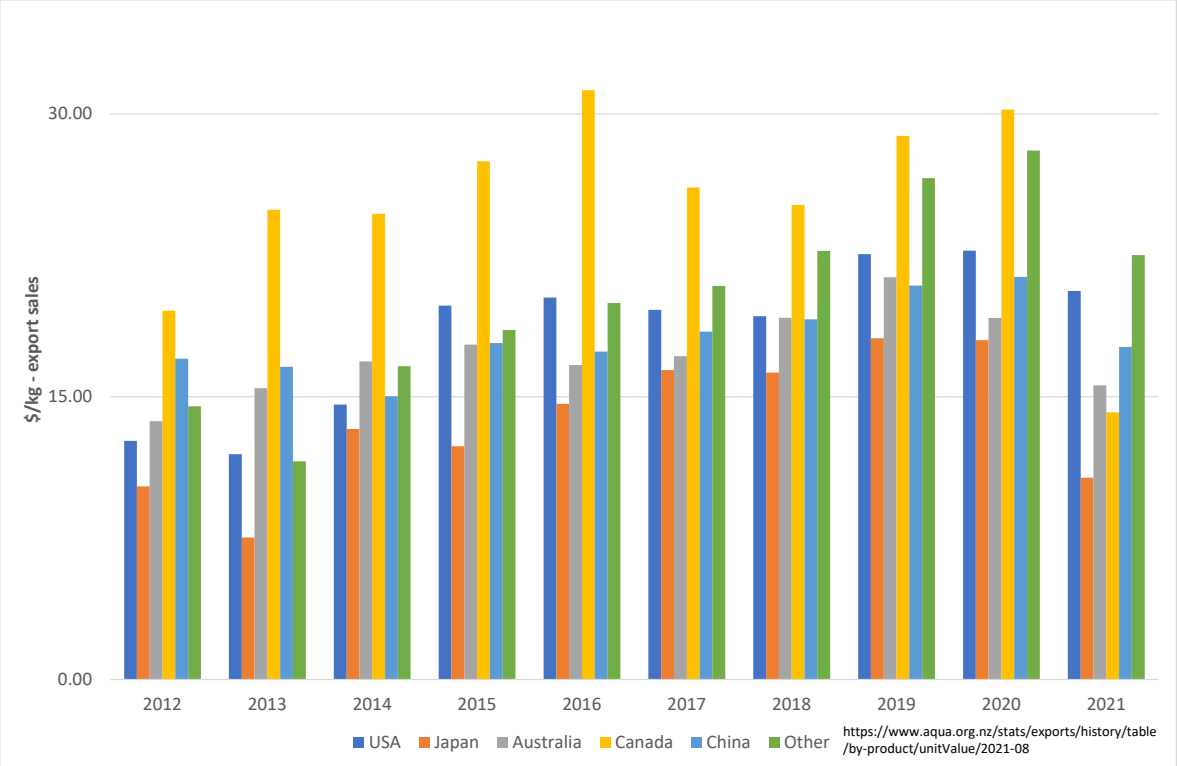


Figure 4 Export value ($) per kilogram (top five countries by volume)



86. Revenue per kilogram in Figure 4 are averages across a range of standard product specifications.[18] The mix of products and prices vary considerably between markets and this causes the differences in averages between markets. For example, exports to the USA are dominated by chilled whole product. Frozen whole product is a large component of exports to Japan, which yields lower prices than chilled whole.

87. Exports to Canada prior to 2021 included a significant amount of frozen fillets. This product specification yields relatively high prices and they have tended to be particularly high in Canada. In 2021, exports to Canada were predominantly frozen whole products, which yield lower prices than frozen fillets. Prior 2021, Canada took very little frozen whole product, hence the considerably reduction in Canadian average export revenue for kilogram in 2021.

[18] Chilled whole, frozen whole, chilled fillets, frozen fillets, smoked, processed packed, processed cans or jars (whole), salmonidae

3. Industry value chain

88. The activities that together are required for the production and sale of salmon are represented in Table 1. This is referred to in this paper as the value chain.

89. The table provides an indication of the components of the value chain that might be undertaken by a salmon farming business or could be provided by a third party. Many of the components can be either undertaken by salmon farming businesses themselves or delivered by third parties.

90. Review of salmon farming businesses in the Northern Hemisphere suggests that the larger companies prefer vertical integration across the entire value chain. For example, Mowi, the largest salmon producer in the world is fully vertically integrated, including owning feed mills.[19]

91. The rationale for vertical integration appears to be that full control enables greater surety about and control over product quality and quantity, with the added benefit of being confident about sustainability credentials, which is an increasingly important regulatory and marketing requirement. New Zealand King Salmon has stated that:

> "*We believe a key component to ensuring the highest possible quality and brand positioning is retaining complete vertical control, enabling year-round production, processing and supply of high-quality salmon.*
>
> *We control all elements of the value chain from breeding and growing through to harvest and processing. Fish are harvested and processed on the same day with fresh whole fish generally dispatched to customers within 24 hours of harvest.*"[20]

92. Industry scale and maturity in some other countries, primarily Norway, is such that it has been possible for businesses to specialise in providing specific aspects of the value chain. This has allowed some salmon farmers, particularly smaller scale producers to avoid having to invest in all elements of the value chain by contracting third parties to provide services. In doing so they have to rely on contractual arrangements to ensure the quality of service they receive. This gives rise to risks that are different to the risks if those services are part of the business' own value chain i.e., the services are internalised.

93. Discussions with various parties undertaken for this review suggest that "organisation" of the value chain for open ocean salmon farming is evolving. The indications are that if the industry develops along the lines envisaged by current potential participants then each will develop its own value chain, similar to the structure of the current inshore/freshwater salmon farming industry. Whether this will work for the rapid expansion in production and sales volumes to meet the challenge set out in the Roadmap, achieve greater inclusiveness and be the most efficient way to utilise scarce resources is questionable.

Table 1 Salmon farming value chain

Supply chain activity	Undertaken by salmon businesses	Provided and/or owned by third parties
Consenting	✓	✓
Onshore infrastructure: roads, wharves, telecommunication networks		✓
Onshore physical assets: hatchery land, buildings and plant and equipment	✓	✓
Technical solutions: software, advisory services – farm development and		✓

[19] "*We believe there are benefits to vertical integration, due to the greater capacity it gives us to control the production process. … Our integrated production helps us stabilise costs, control the quality of our products and improve efficiency. Over time, vertical integration is expected to result in more stable earnings and unlock future growth. We expect to be less exposed to the cyclical nature of salmon prices, and to be better able to control the quality of our products. An important prerequisite for building the MOWI brand and gaining brand awareness is to gain consumer trust, and through Mowi's integrated value chain, we believe that the company can differentiate the way our products are perceived, positioned and sold.*" 2020 Annual Report: P15; MOWI

[20] New Zealand King Salmon Operations Report: P9; New Zealand King Salmon Limited. https://www.kingsalmon.co.nz/new-zealand-king-salmon-operations-report/

Supply chain activity	Undertaken by salmon businesses	Provided and/or owned by third parties
operations.		
Offshore assets: barges, boats, feeding systems, cages, mooring systems, remote communications	✓	✓
Feed production	✓	✓
Onshore production (hatchery operations)	✓	✓
Offshore production (farming: growing product to harvestable size/condition)	✓	
Processing – both primary and secondary (value adding)	✓	✓
Marketing and sales	✓	✓
Management of transport and distribution requirements	✓	✓
Delivery of transport and distribution services		✓

4. Open ocean salmon farming in New Zealand

Introduction

94. There have been a small number of mussel farms developed in the open ocean in New Zealand waters in recent years but there are no open ocean salmon farms, or any other fish farms yet. The technology and science for open ocean salmon farming in New Zealand are not yet proven to the level needed to be confident that the industry can grow production at a rate that will generate $1.5 billion in revenue before 2035 and that it will be financially viable, both during the growth phase and thereafter. Nevertheless, there are businesses that are investing to progress plans to develop open ocean farms and so are putting capital at risk. Three parties have lodged applications for four resource consents for offshore water space for salmon farms.

95. It is reasonable to assume that, in the absence of Government intervention, development of farms and other components of the value chain will progress on a time frame and on a scale initially to accommodate prudent risk management and to enable development of technology and operating models in ways that maximise the probability of achieving financial viability. But this rate of development may not be bold enough to reach total industry revenue of $1.5 billion within the time scale envisaged by the Roadmap.

96. The barriers to faster development of the industry are complex. They include commercial risks and non-commercial, public policy matters.

Market considerations

97. The increase in salmon production and sales needed to achieve the Roadmap revenue objective is considerable. New Zealand currently produces approximately 15,000 tonnes of salmon annually. This will need to increase to approximately 70,000 to 80,000 tonnes per annum to support the revenue growth objective. Almost all the volume increase will have to be exported and sold at prices that will deliver enough cash flow to provide the required return on and of the considerable capital needed for the development and operation of onshore facilities and offshore farms.

98. Production of 70,000 – 80,000 tonnes per annum will translate into 50,000 to 60,000 tonnes of saleable product after processing. The increases in production and saleable product amounts over current levels are approximately 55,000 to 65,000 tonnes and 46,750 – 55,250 tonnes respectively. New Zealand currently exports 5,000 tonnes per annum. So, if all the increase in saleable product will have to be exported, as suggested above, then there will need to be an eight to nine times increase in exports.

Table 2 Production, saleable product and exports

	Current	Future objective		Increase	
Tonnes		**Low**	**High**	**Low**	**High**
Production	15,000	70,000	80,000	55,000	65,000
Saleable product[1]	12,750	59,500	68,000	46,750	55,250
Exports	5,000	51,750	60,250	46,750	55,250

[1] Estimated assuming one tonne of salmon harvested produces 850 kilos of saleable product

99. It is not certain that export markets will absorb the increase of 46,750 to 55,250 tonnes of New Zealand produced salmon annually at prices that will ensure industry viability. New Zealand farmed salmon is King (Chinook) salmon; most of the farmed salmon produced elsewhere in the world is Atlantic Salmon. New Zealand King salmon is *"largely considered to be the highest quality salmon product on the market in terms of flavor, texture and nutritional content. As a result of the high quality and low supply, Chinook salmon fetches a premium price both locally and internationally*".[21]

100. Whether the difference between the Atlantic and New Zealand King salmon is sufficiently discernible that it will support greater volumes of New Zealand salmon while maintaining the price premium is not certain. However, it is instructive to note that New Zealand's current production (15,000 tonnes per annum) compares to global production of

[21] https://niwa.co.nz/aquaculture/species/chinook-salmon

approximately 2.7 million tonnes per annum. If New Zealand's annual production reaches 70,000 to 80,000 tonnes, then this will be just 2% of farmed salmon output, assuming no change in global production, which is highly unlikely. For example, Norway has recently released a new strategy, "A Sea of Opportunities," that provides a blueprint for the Norwegian aquaculture industry for the next 10-15 years. The strategy includes an objective of growing the production of salmon and trout per year to 5 million metric tons by 2050, which is almost five times the current volume.

101. So, New Zealand production is and will continue to be a very small percentage of total global farmed salmon output. Therefore, it might be possible to conclude that increasing production to 70,000 – 80,000 tonnes and exports to 51,750 to 60,250 tonnes per annum can be done with minimal disturbance in the target markets. But being able to sell it is one thing; selling at prices needed to deliver the required rate of return is another, although it is encouraging to note the trend of increasing average price per kilogram for exported product demonstrated in Figure 2, albeit the volumes are very small.

Stage of development

102. Open ocean aquaculture is in its infancy in New Zealand. Open ocean farming outside of enclosed bays will require a technology shift – existing technology must be adapted to perform in open ocean environments.

103. Analysis and research is underway to identify appropriate farming technologies for New Zealand conditions – there may be more than one solution as companies will implement the technology best suited to their particular requirements and farm locations. This is evidenced by the farm designs developed or being developed by the parties that have lodged applications for open ocean farming resource consents. The designs appear to have different features, reflecting in part different farm locations and differences in factors such as technology strategies, plans, constraints and risk appetite.

104. Technology in this context encompasses both the infrastructure needed to contain and rear the salmon and the operating methods needed to successfully and cost effectively grow the fish to their optimal weight within acceptable time periods. This must take into account that of "*all the salmon species, King salmon are the most challenging to farm. They are notoriously fussy and can be difficult to handle without causing damage*".[22]

105. Open ocean fish farms are being developed and operated elsewhere in the world. New Zealand can learn from these operations and potentially adopt technologies and farming methods being used in other countries. However, it is likely that adaptation will be required together with bespoke innovations to ensure open ocean farming produces optimal volumes of high-quality product in a financially efficient manner.

Regulatory framework

106. The current regulatory environment governing consents needed to establish and operate marine farms is challenging. Almost all consents issued to date have been for inshore farms. The consenting process has proven to be time consuming and not without controversy. This makes the process costly and uncertain for developers/operators.

107. The application of the regulatory framework to open ocean farming is being tested in relation to the four open ocean salmon farm consent applications that have been lodged to date. It could be reasonable to extrapolate from the experience of the inshore consenting processes and conclude that consents for open ocean farming could be more rather than less challenging, not least because it is a new activity.

108. Locating farms in the open ocean will have upsides in that it will move them away from areas of highest competing use. Also, degradation of the environment may be less in high energy locations. But there will be new challenges such as the need to manage interactions with rare and endangered birds and mammals.

109. There is a risk that the regulatory framework may not be able to deal with open ocean farms in a manner that gives developers enough certainty about the process and the cost-effective issuance of consents in a timely manner to proceed at pace with their development plans. Managing uncertainty can be challenging under the current RMA.

110. The Government is aware of the challenges the RMA creates for cost effective and timely development of aquaculture projects and that this is not a problem unique to the sector. This is one of the reasons for the Government's plans to repeal and replace the RMA. Its objectives in doing so include better enabling development within natural environmental limits, improving system efficiency and effectiveness and reducing complexity while retaining appropriate local democratic input.

[22] https://www.kingsalmon.co.nz/our-salmon/.

Benefits to New Zealand

111. As a new industry, there is an opportunity to develop in a way that maximises the retention of financial benefits from open ocean farming in New Zealand. Most of the labour, trades and professional services needed to develop farms are likely to be New Zealand domiciled. Similarly, most labour, contractors and trades required for operation of the farms and the allied activities will also be New Zealand domiciled.

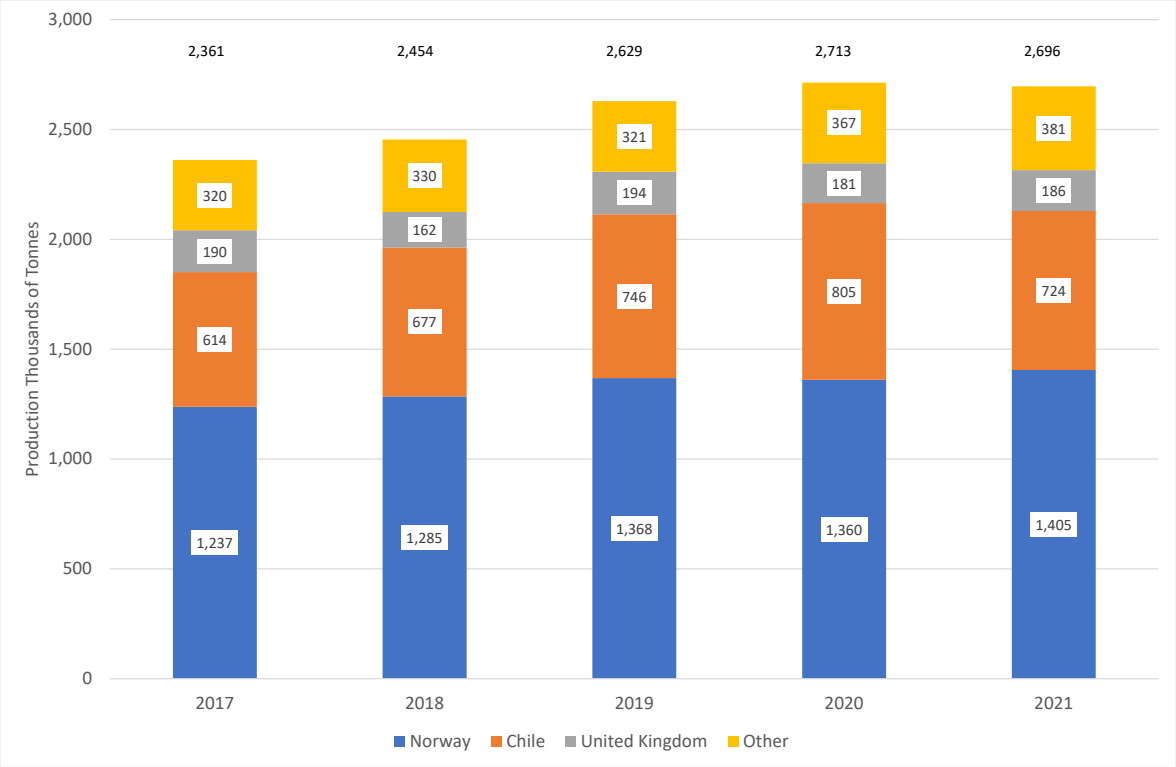
112. The opportunity to maximise financial returns to New Zealand from open ocean farming also relates to the returns to capital – who owns the open ocean farming businesses and who finances them. Are dividends and interest/principle being paid to non-New Zealand investors?

113. The amount of capital, expertise and technology needed to develop the quantum of infrastructure and assets to produce the volume of product that will generate $1.5 billion in revenue will be considerable. The risk profile of the early developments will likely be quite high. If New Zealanders are not willing to provide sufficient capital to the industry, then achieving the Roadmap challenge will not be possible if there is not another source of capital.

Industry scale

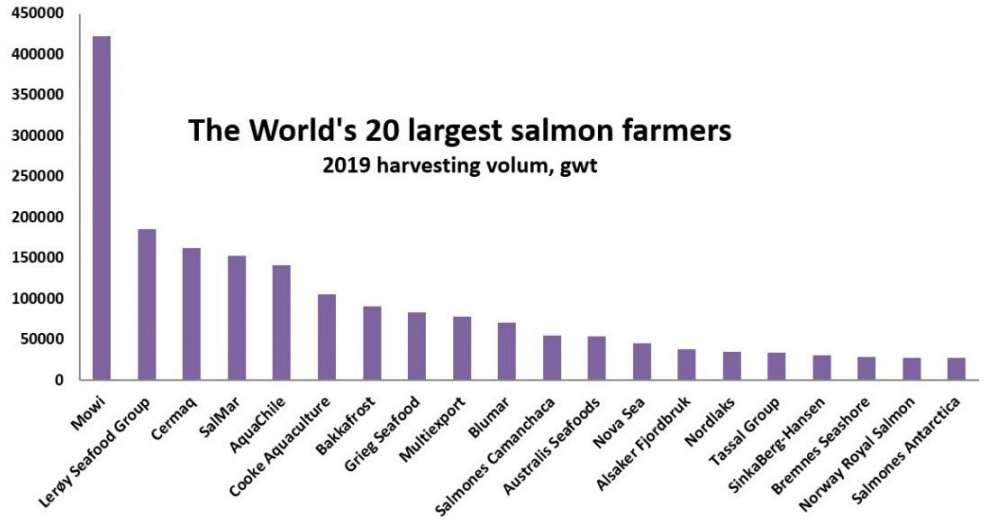
114. Estimated total global salmon production is presented in Figure 1. Global production is almost all Atlantic salmon, whereas New Zealand is producing King (Chinook) salmon. This distinction is important but nevertheless, New Zealand current production of 15,000 tonnes per annum is a small fraction of global production, just over 0.5%.

Figure 5 Global farmed salmon production



115. Even total New Zealand production of 80,000 tonnes of salmon per annum is small – there are individual companies that produce more than this volume on an annual basis.

Figure 6 Production of the largest international salmon farming businesses



Source: https://cdn.innocode.digital/salmonbusiness/uploads/2020/07/20large-1140x662.jpg

116. There will be economies of scale in some parts of the value chain. Hatcheries and processing facilities will provide some opportunities for efficiencies from size. Feed mills are scale dependent. Annual fish production of at least 30,000 tonnes per annum would be required to justify construction of a feed mill. There will be an optimum size to individual farms – at least 10,000 tonnes production per annum. Scale benefits in the farming operations will likely be linked to labour and support services (e.g., well-boats) more than to the pen infrastructure.

117. The New Zealand industry will likely be made up of several small participants, by global standards. Benefits could accrue to the industry by participants taking a collaborative approach to those components of the value chain that offer scale advantages. Organising and achieving enduring joint venture arrangements to deliver these benefits will require the participants to willingly cooperate for the greater good. This will have its challenges.

Māori economic development

118. The Maori Commercial Aquaculture Claims Settlement Act 2004 (Settlement Act) provides for full and final settlement of commercial aquaculture claims under the Treaty of Waitangi. The Act gave effect to the Crown's obligation to provide iwi with 20 per cent of the value of existing and future marine aquaculture space. It provided for allocation of aquaculture assets, such as authority to develop aquaculture space, a cash equivalent, or both. This obligation applies to the allocation of any new aquaculture in the territorial sea (not exceeding 12 nautical miles from the coast)[23]. The settlement does not apply in the exclusive economic zone (more than 12 but not exceeding 200 nautical miles from the coast), and potential interests would need to be resolved should development occur.

119. Outcome 4 of the Aquaculture Strategy recognises the link between the Crown's obligations under the Settlement Act and the opportunity to facilitate Māori economic development through participation in the development and growth of the aquaculture sector. This has the potential to provide significant benefits to Māori while at the same time providing a mechanism for the Crown to meet its obligations under the Settlement Act and contributing to the growth it is seeking from the aquaculture sector.

120. The Crown has several options for discharging its obligation. It could provide affected iwi with a cash settlement. This would be a relatively simple approach. However, it is not consistent with the inclusiveness strategy objective and there will likely be iwi that will want to have an involvement in the industry and be part of its development and growth. This is consistent with the objective in the Aquaculture Strategy to deliver the Crown's aquaculture settlement obligations in a manner that facilitates early investment in new opportunities.

[23] Section 9 Crown's obligations in respect of new space states that the "*Crown must ensure that the trustee is provided with settlement assets that are representative of 20% of the new space…*". New space is defined in the Act as "*space that, after the commencement of the [Act], first becomes subject to a coastal permit to occupy the space for the purpose of aquaculture activities that has commenced under section 116A of the Resource Management Act 1991…*"

121. More complex options could include the Crown co-investing with one or more iwi in some or all parts of the value chain. However, a one-size-fits-all solution to partnering or co-investing will probably not be the best solution – there will likely be a need for a range of options that encompass partnering at the national, regional or iwi level. Developing these options will require consulting and working with iwi. Such engagement was not within the scope of this paper.

122. Developing and implementing solutions that enable the Crown to discharge its obligation in a manner that fulfils the aspirations and expectations of all affected iwi could take time. The administrative processes to achieve this will need to minimise the risk of adding to the complexity and uncertainty that prospective open ocean farm investors and operators will face in successfully establishing profitable businesses of scale.

123. While the Settlement Act provides a rationale for interventions to assist with Māori involvement in the development of the open ocean salmon farming industry in particular and the aquaculture sector more generally, there is a broader range of objectives that support partnering with Māori to progress economic development and realise the potential of the Māori economy. Recent investments made by the Government through the Provincial Growth Fund to support aquaculture in the Bay of Plenty are one such example.

Summary observations

124. The matters discussed in this section have important implications for the financial viability of open ocean farming in New Zealand. In particularly they suggest a level of uncertainty and risk that will need to be addressed to attract the considerable capital needed to rapidly grow annual revenue to $1.5 billion. Capital will be required to develop and prove the technology/science, construct the farms, develop onshore infrastructure, and finance operations as they ramp up to reach critical mass.

125. Risk can be accommodated by the providers of capital through the price (rate of return) they require for providing capital. The higher the risk, the higher the rate of return. But a higher rate of return means more of the business' cash flow needs to be used to service capital, which accentuates the need to maximise revenue and optimise costs to ensure ongoing financial viability.

126. However, there will be a point where the risks are such that capital providers will not be prepared to participate or their required rate of return is at a level that cannot be serviced, which means that the development will not be financially viable.

127. While private sector investors may have an interest in the aquaculture sector, they could be hesitant to commit capital for offshore salmon farming over a timeframe consistent with the Government's ambitions, where technologies, operating methods and other critical success factors are unproven at scale and organisation of the value chain is not fully developed.

128. A rational approach to mitigating these risks would be to take an incremental approach to development – have a series of key milestones linked to reducing uncertainty and risk, with capital being raised over time to finance identifiable stages of development. The cost of the capital will reduce as milestones are achieved, confidence about financial viability grows, the long-term plan for the industry is more fully formed and outlook for the industry becomes more assured.

129. The issue for the 2030 objective is not whether this is an appropriate approach to industry development. Rather, it is the timeframe over which the development will occur. Salmon farming in New Zealand started 40 years ago and current production is 15,000 tonnes per annum.[24] The challenge for the industry now is to increase production to 70,000 to 80,000 tonnes, a fivefold increase, in ten years by growing salmon in open ocean farms, a technology that has not been used in New Zealand. The enormity of the growth challenge should not be underestimated.

130. A key objective of intervention by the Government, if any, would be to assist the industry reduce uncertainty and risks about operational and financial viability to levels that give investors enough confidence to provide the capital needed, at an affordable cost, to develop the industry at the pace required to support achievement of the 2030 objective. In goes without saying that the benefits of any such intervention will need to more than outweigh the costs.

---

[24] "*New Zealand's first commercial salmon farm was established in 1976 as an ocean ranching venture … in Golden Bay and made its first sales of freshwater-reared salmon in 1978. … The first sea-cage salmon farm was established in 1983 in Stewart Island's Big Glory Bay … This was soon followed by the development of farms in the Marlborough Sounds.*" The New Zealand Salmon Farmers Association http://www.salmon.org.nz/new-zealand-salmon-farming/history/

5. Issues for industry viability and growth

131. There were a wide range of matters raised and observations made by parties interviewed for this review about how the industry might develop. Interviewees were largely positive about the prospects for the industry. New Zealand King salmon has been positioned as a premium product, reflecting among other things that it has nutritional attributes that are considered superior to those of Atlantic Salmon. But the interviewees are also concerned about the many issues and risks that will need to be dealt with to allow the industry to be viable.

132. The following is a summary of the principal obstacles and barriers that will need to be overcome if the industry is to develop at pace and be financially viable. This is not intended to provide a negative view of the industry's prospects. Rather, it provides a guide to where and how the Government might intervene to accelerate the pace of development.

Resource consenting

133. Issues with obtaining consents and operating within consent conditions for marine farming were the number one concern for many of the interviewees. Some offered the view that changes to planning and consenting processes to address their concerns would have the greatest positive impact on progressing the development of the industry and that further Government assistance may not be needed.

134. It is not the purpose of this paper to provide an in-depth analysis of the Resource Management Act 1991 as it relates to consenting of marine farms in general and open ocean salmon farms in particular or to present options for policy responses to address industry concerns. However, planning and consenting will be an issue for almost all components of the value chain and will have an influence on the commerciality and financial prospects of the industry. It is a bit hard to ignore it.

135. The following is a summary of the matters raised by interviewees.

- Cost: the direct costs of obtaining the necessary consents to establish and operate a marine farm are reasonably significant. The cost is a particular burden as open ocean farming is in the early stages of formation and the money could be better spent on research and development.
- Uncertainty: consent applications are lodged with considerable supporting evidence and research. However, although applicants might consider their case for a consent is strong and well supported, they cannot be certain:
    - Whether a consent will be issued.
    - If a consent is issued, whether will it allow production at the level included in the consent application.
    - What conditions will be included.
- Operational constraints:
    - Operating parameters such as feed volumes can be pared back during the consenting process, which impacts the capacity of the farm and operating efficiencies.
    - Lack of flexibility: the need to be specific about what is to be constructed and how farms will be operated constrains the ability to adapt, change and modify. Growing conditions and farming operations cannot be predicted with complete certainty. It is almost inevitable that actual operations will be different to forecasts. Not being able to modify operations to accommodate changing conditions compromises operating efficiency.
    - Inconsistency in consent conditions between regions.
- Time taken to make consent decisions: time frames are drawn out and not conducive to making time-effective investment decisions. This impacts on planning and downstream activities such as market development.
- Tenure: the term of the consent[25] also impacts returns from investment as does the certainty of consent renewal. Decisions about reinvesting in assets and systems become increasingly challenging as consent expiry dates draw nearer. Consents can be and are renewed. However, investing in new assets on the assumption

[25] The statutory minimum duration of consent under the RMA is 20 years, but there is scope for tenure of up to 35 years.

that a consent will be renewed is not without risk. Moreover, even if a consent is renewed it is not certain that existing conditions will remain unchanged or be modified or whether there might be new conditions.

- Scope for submissions: if a council decides that a consent application is to be publicly notified, then anybody can make a submission on the application. This has the potential to increase the time and cost of the consent process and the uncertainty about the outcome.

136. Most interviewees considered that the combination of these factors makes consenting a major hurdle for development of the industry. It is of such importance that it could deter some parties and investors from participating.

137. A timely and cost-effective consenting process is needed to incentivise participation. Making changes to the consenting process to improve timeliness, reduce uncertainty about outcomes and increase flexibility will go a long way to addressing interviewees concerns.

138. There are a range of regulatory models used in the major salmon farming countries around the world.[26] A consistent theme though is that regulatory compliance is becoming more stringent, with consequential cost increases, and that regulations, together with biological conditions, tend to restrict supply.[27]

139. The work being undertaken by MPI on changes that could be made to the regulation of salmon farming in New Zealand includes a review of regulatory regimes used elsewhere. This is will be helpful as there may be elements of these other regulatory regimes that could be used to enhance the "New Zealand model".

140. For example, in Norway licences are attached to biomass. These licences can be moved by the licence-holder between different aquaculture areas depending on environmental conditions and market requirements.[28] Licenses can also be sold and pledged, and legal security is registered in an Aquaculture Register.[29]

141. This approach is but one example but it has merit in that it allows specifically for regulation of the total biomass, by limiting the number of licences on issue at any one time, but at the same time provides the licence holder with flexibility that could help farmers avoid being trapped into marginal or unsuitable sites and assist the industry in becoming more resilient and adaptable to changing conditions.[30]

142. It also worth noting that the Norwegian government has a process in place to auction new biomass[31] being made available to the industry and has recently imposed a production fee of NOK 0.4/kg of salmon produced (6.8 cents per kilogram).

Iwi inclusiveness

Scale

143. There are iwi with capital that may have an interest in open ocean salmon farming. However, given the risks involved and the quantum of investment needed to develop an open ocean farm of sufficient scale, some form of partnering with other knowledgeable experienced investors would be a sensible way for many iwi to enter the industry. This will assist prudent management of capital, limiting the proportion of each iwi's total capital exposed to what will be a relatively high-risk investment, at least in the establishment phase.

Location

144. A factor that might influence which iwi will have an interest and in what form is that that most suitable open ocean locations for farms will be off the east and south coasts of the South Island, which is the rohe moana o Ngāi Tahu. Further, the onshore activities will likely be sited in the South Island to ensure cost effective links with the farms.

145. Whether this is a barrier to achieving large scale involvement of iwi, particularly North Island iwi in the industry will need to be investigated. There will be mechanisms that could be employed to encourage iwi involvement but most will likely involve some form of direct Government intervention.

---

[26] The Norwegian Aquaculture Analysis 2020: P17; Ernst & Young.
[27] Salmon Farming Industry Handbook 2021: P77; Mowi.
[28] Farming the Sea – Marine Aquaculture within Resource Management System Reform: P104; Environmental Defence Society. August 2019.
[29] Salmon Farming Industry Handbook 2021: P81; Mowi.
[30] Farming the Sea – Marine Aquaculture within Resource Management System Reform: P104; Environmental Defence Society. August 2019.
[31] Salmon Farming Industry Handbook 2021: P84; Mowi.

Skills and experience

146. There will be iwi with experience in operating aquaculture businesses, mainly mussels. There will also be iwi with experience in fishing businesses more widely, and importantly, with experience and expertise in developing brands and marketing and selling food and beverage products generally and seafood products in particular. However, no iwi are currently directly involved in the New Zealand salmon farming industry and it is likely they will need to develop skills and experience to develop and then operate an open ocean salmon farm.

Objectives

147. The rational for investing in open ocean salmon will vary between iwi. Some may see it as an investment opportunity that has the benefit of using natural resources in a sustainable way to produce high quality food. Others with a strong connection to the sea and the food that it produces may consider involvement in open ocean salmon farming as a natural progression in their sustainable use of the ocean's resources. It will allow iwi to practice their kaitiakitanga and rangatiratanga within their rohe. It also aligns to the multi-generational aim of ensuring the sustainability and productivity of the iwi. Opportunities for employment of tangata whenua and the social and community benefits that brings will likely feature highly in the ranking of objectives of most if not all iwi.

Nature of involvement

148. How iwi will want to be involved will in part flow from their objective in becoming a participant in the industry – an investor, and perhaps a passive investor or a more active, hands-on participant. Other factors will also be important, such as whether iwi already have aquaculture experience – as an operator and/or investor.

149. Similarly, where iwi want to be involved in the supply chain could also vary – for example, some may prefer to be involved in onshore operations as opposed to the farms themselves.

Contributions

150. Different iwi will be able to contribute different "assets" to an open ocean salmon operation. Some might have water space, some might have aquaculture experience, others might contribute capital. Still others might have land or other related assets for onshore activities.

Issues

151. These factors, when taken together, suggest that:

- There cannot be a one-size-fits-all approach to the nature of individual iwi involvement in the industry. The circumstances of each iwi will be different and these differences will need to be accommodated.
- Many individual iwi may need to partner at the outset with other participants in some form if they are to have a meaningful stake in the industry.

  Some iwi may be open to partnering with existing industry participants, while others may not. On the other hand, the Crown, as the treaty partner could be the natural partner for this sort of venture, particularly given the Crown's obligations under the Treaty of Waitangi and the Settlement Act. However, again, different iwi may have different views on the attractiveness of being bound up with the Crown in what will be a commercial enterprise. There will be a trade-off, in part between the security and risk mitigation benefits of Crown involvement on the one hand and the issues of having Crown scrutiny and oversight on the other.

  If the Crown were to partner with iwi to assist with their entry into the industry, then it would probably be beneficial for both parties for the arrangement to include the Crown exiting at an appropriate point. The mechanism to facilitate Crown exit will depend in part on the nature of the arrangement but as a minimum it will likely need to include a first right of refusal for iwi to acquire the Crown's interest.

152. The time needed to establish financially viable open ocean salmon farming operations of sufficient scale to achieve the 2030 target date means there will not be an abundance of time available for individual iwi to determine the nature and extent of their involvement in the industry and to develop partnering arrangements. There will be a need to move at pace with a prudent degree of urgency.

153. One further issue is that it is likely that most, if not all, of the water space suitable for open ocean salmon farming will be located along the east coast and south coast of the South Island – this being the area where sea temperatures are in the range needed to grow salmon. Respect for the position of Ngāi Tahu on both sea-based and land-based developments could be a consideration for other iwi seeking an involvement in the industry.

Farming technical solutions (infrastructure and operations)

154. The ability of proposed farming infrastructure to cope with New Zealand open ocean conditions is a critical issue. The New Zealand industry is fortunate in that open ocean farming technologies are being developed, trialled, or used in other countries. The industry does not need to be at the leading edge of technology development. However, there are two important caveats to this:

- Technology used in other countries and environments will not necessarily be usable without adaption or modification. New Zealand open ocean conditions will be different to those that have influenced the design of open ocean pens and related technology in Norway, Chile, and Scotland, where the development of open ocean salmon farming is being pioneered. China is also probable participant in the industry. However, the level of production from open ocean farms globally is still relatively small. Our closest salmon farming rival, Tasmania, does not have any true open ocean farms and none are on the horizon, although it has an objective of growing its industry revenue from $800 million currently to $2 billion by 2030.
- The open ocean farms being operated or trialled in Norway, Chile and Scotland are producing Atlantic salmon. Pens and operating methods may need to be adapted or designed to accommodate the specific characteristics of New Zealand King salmon. Key issues include:
    - Whether growth and mortality rates can be managed to levels that will support financial viability.
    - How the fish are managed in relation to the farming infrastructure, bearing in mind that New Zealand King salmon are more fickle and perhaps not as robust as Atlantic salmon. There will be animal welfare and operating efficiency implications for how farming methods are designed to maximise outcomes given the nature of the farm infrastructure and technology.

155. There will be scale issues that will need to be addressed while the farms are ramping up to full production. For example, the size of service vessels will be one important consideration – well boats would likely be required to maximise efficiencies, but these are costly and will be challenging to justify before scale is reached. Whether individual participants investing alone in such expensive assets is cost effective is not certain.

Research

156. The need for research to support adaptation of open ocean farming infrastructure to New Zealand conditions and to assist in ensuring farming methods will be appropriate given open ocean conditions, features of the farming infrastructure and the particular characteristics of New Zealand King salmon was raised by a number of interviewees.

157. Research organisations such as National Institute of Water and Atmospheric Research Limited (NIWA) and Cawthron Institute are actively involved in providing research services to the salmon industry. However, interviewees noted that specific research is needed for open ocean farming and that it is important that the research is focused on the particular needs of the industry and, importantly, addresses issues at a practical level. This requires research organisations and industry participants to be working closely together on matters the industry identifies as critical to the successful development of sustainable and profitable operations.

158. The Crown Research Institutes have recently released a strategy document that identifies that a "*robust and productive science system will be essential for creating a better future for Aotearoa New Zealand, economically, environmentally, culturally and socially*".[32] The themes set out in this document are aligned with those underpinning the Roadmap and the Aquaculture Strategy. In particular, the document notes that:

> *"The core mission of CRIs is to protect and advance Aotearoa New Zealand's current and future prosperity and wellbeing.*
>
> *For Aotearoa New Zealand to become a more productive, sustainable and inclusive economy and realise the Government's vision, we need RD&I to address economic, environmental, social and cultural ambitions; realise opportunities that arise from improvements in the sustainable production of goods and services; safeguard our natural capital assets, including biodiversity and our soils; and increase the effectiveness of public services.*

[32] Pathways to the Future, A strategy to lift the positive impact of science on Aotearoa New Zealand's economy, environment, society and cultures: P2; the New Zealand Crown Research Institutes. 1 September 2021

Our focus is Research, Development and Innovation that is useful, usable and used."[33]

159. Confirmation of a need for a focus on useful, usable and used research is encouraging. However, the issue identified by interviewees is ensuring that the process for commissioning, managing and funding research ensures that the outputs are "*useful, usable and used*".

Supporting infrastructure

160. Wharves, utility services and communication infrastructure will be required. Existing infrastructure may suffice but it will depend on where farms and onshore facilities are located. It is not certain who should finance any capital expenditure required to remediate, upgrade or construct new assets that might be considered public assets, such as wharves, roads and three water assets.

Onshore facilities

161. Ownership and financing of onshore components of the value chain, particularly hatcheries and processing facilities will need to be addressed. There are scale economies in these facilities, more so than farms. Do industry participants need to be vertically integrated? Does ownership of onshore facilities provide a competitive advantage?

162. Some participants might consider the onshore components of the value chain to be strategically important and so might want to control these. For example, product specification, the extent of secondary processing and packaging could differentiate one brand from another. Similarly, management of hatcheries and the formulation of feed might be considered to support or give credence to product quality credentials and claims.

163. Whether these factors mean that each participant needs to control and or own all onshore components of the value chain would require further investigation. But there are other models that could be investigated. Toll processing by a third party is established in the meat processing industry. Similarly, outsourcing winemaking and bottling is common in the New Zealand wine industry. As noted elsewhere in this paper, not all salmon producers elsewhere in the world are vertically integrated across the entire value chain.

164. Ownership and control of hatcheries may not be a significant issue so long as the output, smolt, are homogenous i.e., there is no differentiation in fish between businesses. If businesses want or need to make some form of change to the attributes of the fish, for example to enhance or repress certain attributes through selective breeding then control if not ownership of onshore smolt production might be considered a matter of competitive advantage. For example, New Zealand King Salmon have a selective breeding programme that it considers a proprietary asset.

165. Most salmon produced in New Zealand currently is grown from hatcheries and smolt development facilities owned by individual companies. However, there is one dedicated smolt producer, Salmon Smolt New Zealand Limited which is jointly owned by Akaroa Salmon New Zealand Limited, High Country Salmon Limited, Sanford Limited and Mount Cook Alpine Salmon Limited.

166. Feed is the most important operating input in salmon production. There are several issues:

- As the industry grows the demand for feed will grow. Feed for the New Zealand industry at present is mostly sourced from Tasmania, supplemented by feed from Chile.
- Some larger overseas salmon producers have invested in their own dedicated feed manufacturing plants (feed mills). But most producers source feed from specialist feed producers.

  The international salmon feed industry is dominated by three global producers, all of whom supply feed to the Australasian salmon industry:

  - Skretting, which is owned by SHV Holdings, a large Dutch headquartered conglomerate.
  - EWOS, which is part of the Cargill group, a large American company. EWOS is represented in Australia and New Zealand by Big Nutrition, an Australian owned company.
  - BioMar, a subsidiary of Schouw, again a very large conglomerate based in Denmark.

  Skretting and BioMar both have feed manufacturing plants in Tasmania. Skretting announced expansion plans for its plant earlier this year. BioMar opened its plant in April/May 2020.

[33] Ibid: P8

Security of high-quality feed supply will need to be addressed by the industry. A standalone feed mill requires demand, in terms of fish production of at least 30,000 per annum to be financially viable. Development of a feed mill in New Zealand could be sustainable as production levels approach 70,000 – 80,000 tonnes per annum. However, whether one of the international producers would be willing to invest in a mill dedicated to what will still be a very small-scale industry will depend on several factors, not least being a reasonable degree of certainty about the sustainability of the industry and that a New Zealand mill won't become a stranded asset.

It would seem unlikely that a single business in New Zealand will have sufficient scale to justify having a bespoke feed mill dedicated to its requirements. An alternative to an existing feed supplier constructing a New Zealand mill would be an industry solution. For example, the industry participants financing and constructing a plant or third-party investors financing construction on the back of solid take-or-pay type contracts from participants. The risks with these solutions would need to be carefully considered.

Feed is an important determinant of fish quality and productivity. All participants will want nutritious state-of-the art feed. They may want to test alternative ingredients and develop their own formulations that assist with achieving optimal growth and quality attributes and support their sustainable farming credentials. In this respect, businesses might consider feed formulation to be confidential know-how/intellectual property.

These issues indicate that further work will need to be undertaken to determine if it is necessary and feasible to have an industry solution to feed production.

- Salmon feed is typically comprised of:
    - Fish oil: fat from fish parts.
    - Vegetable ingredients: from soy, sunflowers, rapeseed, corn, broad beans and wheat etc.
    - Fishmeal: from fish heads and other parts not used for human consumption.
    - Fish protein concentrate: downgrades from the consumer fishing industry.
    - Vitamins and minerals.

  The focus on and drive for greater sustainability encompasses the whole supply chain. New Zealand salmon producers will need to demonstrate their sustainability credentials – this will be a prerequisite, not a differentiator. This will include demonstrating that feed inputs are being produced sustainable. For example, that growing, and processing vegetable ingredients does not produce excessive GHGs and does not rely on exploitation of resources (natural and human). It will also include commitments to obtaining fish ingredients from sustainable sources – for example, relying on fish ingredients sourced from unsustainable wild caught fish will be detrimental[34].
- Climate change and environmental regulations will likely have an impact on the cost and availability of raw feed ingredients.

167. Review of industries in other countries indicates that vertically integrating onshore facilities with farming, marketing and distribution is an option as businesses get larger. For example, MOWI, which is the world's largest salmon farming company (it harvested 440,000 tonnes in 2020) owns and operates its own hatcheries, feed mills and processing facilities. Being able to control all key elements of the supply chain is important for managing product quality, profitability and sustainability.

168. Size is important for vertical integration because of the substantial capital needed for the construction or acquisition of onshore facilities. Below the few very large companies, the industry globally is fragmented and individual companies are not of sufficient scale to service the capital needed to own all components of the onshore value chain.

169. Outsourcing some onshore processes is not uncommon. However, outsourcing will always require careful management of the allocation of risk for product quality and food safety. Also, there will be considerable commercial risk in financing the construction and operation of a new large-scale facility until the industry's potential and long-term viability are proven.

[34] Growth in aquaculture globally will necessitate greater use of non-fish ingredients, such as algae, as the demand for fish-based feed inputs will at some point exceed the available supply.

Availability of labour and skills

170. Being able to access the knowledge and expertise of individuals or companies that have experience with developing and/or operating open ocean farms will be beneficial to accelerate the pace of development and reduce the time and cost involved in trialling adaptions of technologies and systems to New Zealand conditions. However, as open ocean salmon farming is in its infancy there will not be a substantial number of individuals with the requisite skills and experience.

171. Salmon farming operations are becoming more automated. Nevertheless, there is a need for skilled labour to undertake the various roles needed for efficient operation of farms. There are two issues:

- A substantial increase in personnel numbers will be needed to support the industry as it becomes established and then increases production. A key goal of the Roadmap is that the production increase will provide job opportunities in all components of the value chain for New Zealanders. However, there will be a need to recruit skilled labour from overseas to fill positions in the near term and help with training local personnel. The ongoing expansion of salmon farming worldwide means that there will be competition to recruit the more experienced and skilled people.
- There may be challenges in recruiting enough staff to operate farms in more remote locations. This will impact on relative profitability of individual farms – it will not be just labour that will be more costly for farms that are sited further from onshore facilities and other supporting infrastructure.

172. There is a lack of diversity in the current labour force in the aquaculture sector (this is an issue across the primary sector). Addressing this issue will take time and require considerable effort by all parties involved in the value chain to ensure that participation in the industry is attractive to all sectors of society, or at least hurdles or barriers to diverse participation are minimised or removed, as appropriate.

173. Training organisations have an important part to play in bringing about this change. They should be encouraged to ensure that there are no aspects to their courses that might discourage enrolment by some sectors of society. The objective should be to ensure that there is nothing in the design and delivery of their courses that prevents the profile of their graduates reflecting the diversity in the general population.

Sustainability

174. The Roadmap is clear that the development of open ocean farming must be sustainable. "Sustainability" in its widest sense encompasses several goals and objectives (for example, in 2015 the UN agreed on 17 Sustainable Development goals, which included such topics as no poverty, zero hunger, decent work and economic growth as well as climate action and life below water). For this paper, sustainability has been taken to mean responsible management of resources to minimise carbon footprints and not degrade the natural environment and enhance it wherever possible.

175. While sustainability can and is reinforced through the regulatory environment (e.g., the RMA process to obtain consents), embedding sustainability in all aspects of ocean salmon farming will not be optional – it will be a competitive disadvantage to not be able to demonstrate to consumers that salmon produced in New Zealand is not only nutritious but has been produced sustainably, which will be in step with trends in the New Zealand primary sector more generally. It is apparent that demonstrating sustainability credentials is an increasingly important part of Atlantic salmon producers' marketing efforts.

176. The need to be transparent about sustainability performance is being driven by customers and by the need for salmon farmers to maintain their "social licence to operate". The later requires businesses to provide the communities within which they operate and wider society with confidence that they are operating in a manner that meets appropriate social and environmental standards. This requires businesses to be accountable to communities for the efficacy of their sustainability performance.

177. Sustainability must be practiced through the salmon value chain. Issues for salmon farming will include:

- Feed production: as noted earlier, sustainable feed production will include minimising the carbon footprint of the feed production process and sourcing ingredients that have been produced sustainably. This will pose some challenges for the New Zealand industry, at least initially because of the need to rely on feed purchased from specialist feed manufacturers. New Zealand salmon farmers will have little leverage over these manufacturers that can be used to influence their sustainability credentials. However, most feed companies have clear sustainability goals – it is in their commercial interests to be able to demonstrate that they are producing feed using sustainable inputs and processing methods.

- Carbon footprint of both onshore and offshore operations. Innovation could play a part in providing cost effective, and perhaps even profit enhancing solutions to reduce resource usage, wastage and so on. For example, electric barges are being introduced in European farms. Similarly, robotics, data control and automation are becoming an increasing feature of fish processing operations.

  The carbon implications of airfreight are an issue for the New Zealand industry given our distance from key consumer markets. However, this is also an issue for other salmon producing nations engaged in the international trade in fresh salmon.

Operating economics

178. Farming operating costs will be impacted by capital costs, feed costs, biological costs and regulatory compliance procedures. Overseas experience suggests that while skills and labour are very important, it is not a significant cost for farming operations.

179. New Zealand producers, like Atlantic salmon producers, mostly use land-based hatcheries for smolt production. Cost per kilo for smolt has been rising for Atlantic salmon producers as they are increasing the size of the smolt in hatcheries before release to sea. The cost is expected to be offset by shorter time in sea, less lice treatment (which is not an issue for New Zealand salmon farms) etc.

180. Feed is usually produced close to where it is farmed. Feed is considered a perishable product with limited storage opportunities. The international feed industry has become increasingly consolidated. Together with Mowi, three producers now control the majority of salmon feed output; Skretting (subsidiary of Nutreco which has been acquired by SHV), EWOS (Cargill), and BioMar (subsidiary of Schouw). These companies all operate globally.

181. The feed producers have historically operated on cost-plus contracts, leaving the exposure to raw material prices with the aquaculture companies.

182. Feed and feeding strategies aim to grow a healthy fish as quickly as possible and at the lowest possible cost. Standard feeds are designed to give the lowest possible production cost rather than maximised growth. Premium diets are formulated to give amongst other things better growth rates and higher survival rates.

183. The long production cycle of salmon requires significant working capital in the form of biomass. The investment in working capital needed to support an open ocean salmon scale up to reach maximum production will be considerable – an increasing "pipeline" of fish will be needed as harvest volumes grow.

184. Net working capital varies during the year. Growth of salmon is impacted by changing seawater temperatures. Salmon grows at a higher pace during summer/autumn and more slowly during winter/spring when the water is colder. As the harvest pattern is relatively constant during the year, this can lead to large seasonal variations in net working capital.

Markets, pricing and demand for New Zealand King salmon

185. Growing production volume by five or more times to deliver the growth aspirations for the industry assumes there will be consumer demand for the higher volumes. It is tempting to conclude that as both current and projected New Zealand salmon production are and will be such a small percentage of global production, the increase in export volumes needed to achieve the Roadmap revenue objective will be barely noticeable in the target markets. This and the high quality of New Zealand King salmon will make selling the increased volume less challenging than might otherwise be the case.

186. However, this is not a prudent supposition. New Zealand King salmon is a speciality or niche product. One interviewee for this report said that New Zealand producers compete with one another for customers, which might suggest that there are not as many customers for New Zealand salmon as might be assumed and supports the proposition that it is a speciality product. If there was an abundance of customers, then it would seem less likely that New Zealand producers would be competing given the small volumes produced.

187. Alternatively, it may be that current producers have not yet focussed on opening new markets and developing a wider customer base – it is risky to spread the available limited product too thinly across many customers. Overpromising and underdelivering is not a value enhancing strategy.

188. The other factor to consider is price. If the market is efficient demand will be forthcoming if the price meets the market's expectations.

189. The price that New Zealand King salmon producers receive, which as at a premium to Atlantic salmon, is critical to the industry's viability. The premium is important because the cost of producing New Zealand King salmon is more than the cost of producing Atlantic salmon. Interviewees said that the fish are fickle, can suffer from higher mortality rates, have higher feed conversion rates and can be difficult to handle without causing damage to the flesh. In addition to these production issues, New Zealand is a long way from the major markets for salmon. Like all other New Zealand primary sector exporting industries, transporting product to market is an important cost disadvantage[35].

190. The objective of achieving significant growth in industry revenue is not an end in itself. It must be profitable growth. This will require the increase in available product to be sold at prices that will ensure financial viability. Unless open ocean farming results in a considerable reduction in costs, the price premium will need to be maintained.

191. Therein lies a key challenge – to maintain prices while increasing sales volume fivefold. This would be less of a concern if there was unsatisfied demand in the market. But as one interviewee asked, New Zealand salmon exports are inconsequential in global terms but we manage to command a price premium, so why aren't producers elsewhere in the world farming and selling Chinook salmon? There may be multiple reasons for this but presumably a key factor is that Atlantic salmon are more profitable than Chinook because they are easier and less costly to produce.

192. One further matter to consider is the competitive response to an increase in New Zealand's salmon exports. It may be that the increase will be so small and the product limited in its distribution in markets that it will not warrant a competitive response. However, it is risky to underestimate competitors.

193. In summary, it is assumed that those intending to enter the open ocean salmon industry will only commit the significant amount of capital needed to develop farms and other parts of the value chain when there is enough comfort that there will be demand for the product. To do otherwise would be imprudent and it is reasonable to assume that participants will exercise an appropriate level of caution and undertake the research needed to assure themselves of the demand.

194. There are elements of investigating and assessing market demand that will not necessarily be competitively sensitive. There might be scope for the industry to work cooperatively with the help of New Zealand Trade and Enterprise and/or private sector research organisations to undertake some preliminary research into the size of the market in key regions for New Zealand King salmon and the important determinants of price. Participants then could expand on this information if needed and use it to develop their own strategies and plans.

[35] It might be argued that this is not necessarily a unique problem for New Zealand salmon producers. For example, Norway is a long way from North America and China. But Norway is close to the 450 million people who live in the European Union. Chile is also a long way from China and Asia but a lot closer to North America than New Zealand.

6. Financial analysis

195. The cost of establishing an entire value chain for an open ocean salmon farm will be considerable. Preliminary analysis prepared by MPI suggests that the cost of consenting, onshore facilities and plant (hatchery and processing plant) and offshore infrastructure (pens) and supporting assets (vessels etc.) for an operation that can produce 10,000 tonnes of salmon per annum could be $150 million or more. In addition, there will be operating losses that will need to be financed in the initial years as production increases. Smolt will need to be produced, salmon grown to market weight and marketing and market development undertaken before there is revenue of any substance.

196. Financing for operations will be needed until production reaches the level that will result in positive operating cash flow. How long this will take will depend on several factors, including aligning production with likely demand and the possibility of production issues as the new technology and farming methods are bedded-in.

197. A high-level analysis has been undertaken to provide a preliminary assessment of the financial assumptions that could have a substantial impact on profitability and cash flow.

198. The analysis has been prepared for an operation producing 10,000 tonnes of salmon per annum using the following financial information:

- Estimates of the capital costs to develop an open ocean salmon farming value chain and future selling prices for salmon products, all provided by MPI.
- Projected operating cost assumptions extracted from the Open Ocean Finfish Aquaculture: Business Case.[36]

199. The estimates and assumptions are high-level and indictive. Consequently, the analysis is intended to provide broad guidance on the financial parameters needed to achieve financial viability only. It is not definitive and is not at the level of detail or sufficiently precise enough to form the basis of financial analysis for a business case for open ocean salmon farming. Further, there has been no independent assessment or investigation of revenue or cost assumptions undertaken for this paper. Also, the revenue and cost assumptions have not been validated with industry participants.

200. The future selling price projection is a single average price per kilogram of product sold. This is an average export price, as it is assumed that the domestic market is currently fully serviced and all production from offshore farms will be exported.

201. Using a single price is a simplifying assumption but it has avoided the need to model individual products, for example chilled or frozen whole, fillets etc. Revenue generated from the sale of offcuts and parts of the fish not used for human consumption has been taken into account in the assumption used to convert production weight to export sales weight.

202. The analysis is in the form of projected financial statements for 32 years, assuming it will take two years to secure the necessary resource consents and that the consents will have a tenure of 30 years. The projected financial statements have been used to calculate the net present value of the projected free cash flows and the internal rate of return (IRR).

203. Findings from the analysis include:

- The total capital required to finance the purchase/construction of assets and to finance initial operating losses could be in the region of $250 million.
- It could be seven years from the start of the consenting process to the first year of positive operating cash flow.
- The projected price per kilogram received from export sales is derived by escalating the current average export revenue per kilogram of $21.50. The projections are sensitive to the assumed escalation rate.
- Revenue in the first year that full production (10,000 tonnes) is available for sale is approximately $285 million. Another four to five farms of the same size (five to six in total) and developed at the same time will be required to achieve industry sales revenue of $1.5 billion by 2030.

[36] Envirostrat Ltd. Open Ocean Finfish Aquaculture: Business Case, February 2020.

- IRR scenarios are presented in Table 4. The scenarios are derived by varying two assumptions: the annual compounding price escalation rate and the ratio of saleable weight to production weight, reflecting weight lost during processing.

  Three price escalation scenarios are used in the table: 2%, 4% and 6%. The historical compound annual growth rates calculated from the actual average export prices included in Figure 2 are:

Table 3 Historical compound annual growth rates (CAGR) for salmon export prices

Time Period	CAGR
2007 to 2021	3.9%
2007 to 2020	6.4%
2013 to 2021	6.7%
2013 to 2020	11.9%

The export price in 2021 was significantly lower than in recent years. The period 2007 to 2020 (and 2013 to 2020) are included to demonstrate the growth rates if 2021 turns out to be an anomaly.

From 2007 to 2013 the export price rose and then fell – the 2013 price was similar to the 2007 price. Since 2013 the price has been increasing strongly, apart from 2021. The 2013 to 2021 and to 2020 time periods have been included in Table 3 to demonstrate the strength of the more recent price trend.

The annual escalation rates of 4% and 6% used in Table 4 might be considered ambitious but they are within the range of actual price growth achieved since 2007, even taking into account the 2021 price decrease. On the other hand, a 2% projected annual price increase is a conservative assumption compared to the historical CAGRs.

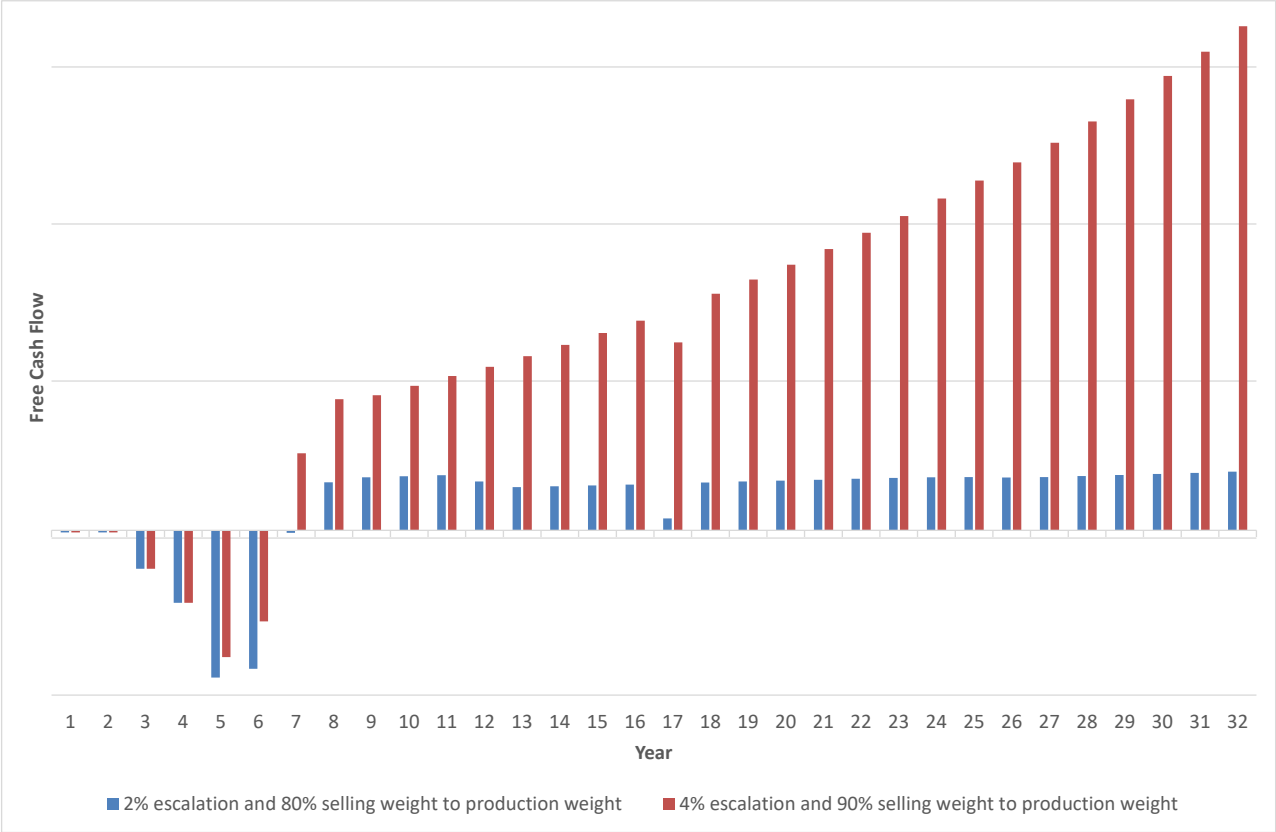
The ratio of selling weight to production weight used in the Open Ocean Finfish Aquaculture: Business Case was 90%. Evidence gathered by MPI suggests that ratio may be lower. Two ratios have been used to calculate the IRR scenarios: 90% and 80%. As noted earlier, these ratios have been set to take into account that there will be offcuts and other parts of each fish that will generate revenue, for example by selling to petfood producers, but a price below the export price.

Table 4 Internal rate of return (IRR) scenarios

32 year IRR	Price escalation		
	2%	4%	6%
Selling weight to production weight: 90%	16.0%	29.8%	34.5%
Selling weight to production weight: 80%	8.9%	23.8%	27.1%

- The differences in the IRRs in Table 4 reflect that the combined changes in the price escalation rate and the ratio of selling weight to production weight have a considerable impact on free cash flow. The following figure highlights this effect. It shows the free cash flow for the following two scenarios:
  - Selling weight to production weight of 70% and a 2% escalation rate.
  - Selling weight to production weight of 90% and a 4% escalation rate.

Figure 7 Free cash flow scenarios



204. The negative cash flows in the early years reflect the capital expenditure needed to construct and/or acquire the onshore and offshore assets and that operating expenditure to ramp up production will be incurred in advance of full revenue potential being achieved.

205. The difference between the two scenarios is a consequence of the simplifying assumption that the increase in sales revenue resulting from the higher price escalation rate (4% vs. 2%) and selling weight to production weight ratio (90% vs. 80%) will result in a one-for-one increase in free cash flow i.e., there is no change to absolute operating costs or capital expenditure. There might be an argument that the higher price escalation rate might require a greater marketing and selling effort but this possibility has not been modelled.

206. The analysis is very preliminary and further work would be needed to validate and refine the assumptions. However, it does serve to highlight that the business has financial risks and that achieving an acceptable rate of return on capital invested will require the selling price to not only remain above the current level but to increase over time. What rate of price increase can be achieved is unknown – it will depend on the market dynamics in each of the regions to be targeted for sales.

207. Figure 2 and Table 3 show that the industry has achieved price growth historically. This is encouraging. However, if the Strategy and Roadmap revenue challenge is to be pursued, then price growth in the future will need to be achieved at the same time as volume will be growing substantially. This will require a concerted marketing and market development effort and New Zealand producers not knowingly competing among each other on price i.e., not undercutting price to achieve volume targets.

7. Intervention

Introduction

208. The issues presented in Section 5 suggest that there are opportunities for the Government to assist the private sector develop a prosperous and rapidly growing open ocean salmon farming industry. Moreover, certain specific forms of assistance or intervention will provide the Government with confidence that its expectations for industry growth that is inclusive, sustainable and resilient will be met.

209. This section contains a long list of possible Government actions and intervention. They range from facilitation through to direct involvement in operations.

210. The implications of international trade agreements and legislation for the interventions haven't been investigated for this paper. This will need to be done if there is an intent to pursue any of the proposed interventions. Also, the political achievability or acceptability of the interventions has not been addressed.

211. Some of the interventions listed will be relatively straightforward to implement, some will be difficult but necessary and some will not be practical but are included for completeness. Also, some of the interventions will take longer to implement than others. The following are some observations on the list:

- Changes to the consenting process is important. This will be complex and will take time, but it is vital to enabling acceleration of industry growth. It will help to reduce uncertainty and development and operational risks, which will assist participants raise the capital needed for development of the farms and onshore facilities.
- Early engagement by MPI with Māori suggests that many are interested in exploring the opportunity open ocean salmon farming presents. However, interest may not necessarily convert into actual investment and involvement once a business case is available and the risks and opportunities become apparent. Further engagement will be required in due course to gauge the true level of interest and to develop options for the nature of iwi involvement.
- A factor that might influence which iwi will have an interest and in what form is that the most suitable open ocean locations for farms will be off the east and south coasts of the South Island, which is in the rohe moana of Ngāi Tahu. Also, onshore activities will likely be sited in the South Island to ensure cost effective links with the farms.

  However, location of itself shouldn't be a barrier to iwi involvement and if there is interest, and it could be interest in not just farms but other parts of the value chain, then Government assistance to make this happen may be necessary. This assistance could provide the mechanism for discharge of at least some of the Crown's obligation to deliver 20% of new water space, or equivalent value, to iwi under the Settlement Act.
- The process for targeting research and development at solving the practical issues that need to be addressed to ensure that open ocean farming can produce high quality fish at scale and in a cost-effective manner needs refining. Interventions to achieve this outcome should be lower in complexity than some of the other interventions and should be implementable in the near term, which is important as there is an immediate need for research to resolve early implementation challenges.
- Addressing shortages in specialist skills is an immediate issue. Allowing the industry to import the skills it needs to cost-effectively develop farms and operating models is theoretically straight forward but is practically challenging given COVID-19 and runs counter to an objective of enhancing local skills and employment opportunities. However, being able to learn from individuals who have been involved in the industry in other countries will assist with increasing the pace of development and reducing the risk of development missteps.
- The industry will need people with skills to work on farms and in the onshore activities. There is a shortage of skilled labour now. The shortage will become an increasing problem as the industry expands and if not addressed could be a constraint of growth. Providing industry specific training to sufficient people will take time so there is need to design and implement solutions as soon as possible. This will require intervention and is an area where Government and the industry could work together to develop solutions.
- Increasing industry production to 70,000 to 80,000 tonnes per annum will not only require development of farms, but will require investment in onshore facilities, for example hatcheries and processing facilities. The market will develop solutions for the onshore services if the industry can demonstrate that it will be financially

viable. However, whether this will be on a timetable that supports rapid growth is not certain. There could be role for the Government assist the industry develop industry scale solutions earlier than individual participants might be prepared to do it they are left to develop their own value chains.

- Market development activity will need to be ramped up to ensure that there will be demand for the growing volume at prices that will sustain the industry. There could be a role for the Government to support an industry approach to market development if the industry can agree to such an approach – it will not be fully effective if some choose not to participate.

  One of the identified interventions is establishing a "single" desk approach to marketing and selling similar to Zespri. This is unlikely to be practical or for that matter feasible. It may be a step too far for the participants and is likely to conflict with some free trade agreements.

Recommendations

212. Changes to the consenting process to reduce the uncertainty, costs and time delays faced by applicants for resource consents is the most immediate and effective way the Government can support industry growth. Other possible interventions that could yield benefits in the near term and provide confidence to participants to move ahead with development at pace are:

- Facilitating iwi involvement in the industry.
- Assisting the industry complete the research and science needed to ensure operational viability and sustainability.
- Addressing the need for specialist skills.

213. Confirming and designing the specific interventions will require consultation with iwi, parties that have lodged resource consents, other potential industry participants and stakeholders to identify in detail their needs and requirements. This consultation should be the immediate next step.

214. Interventions that will contribute to ensuring the supply of appropriately trained labour and assisting the industry with market development ahead of the increase in production will be important in the medium term as the industry moves beyond the establishment phase and production is ramped up. However, investors will want comfort at the outset that all resources needed to ensure long term financial viability will be available or in place when needed. It would be beneficial if the Government was able to signal the full package of interventions early albeit that some will not be needed initially. This will help with confidence, encourage commitment of capital and enable participants to plan with some certainty knowing that the Government will support the industry over time.

Resource consenting

Objective:

- Minimise the uncertainty about whether a resource consent application will be successful or not.
- Reduce the time taken to process and issue consents and reduce the uncertainty about how long it will take for consent decisions to be made.
- Reduce the risk of resource consent conditions compromising operational efficiency.
- Increase the ability to adapt and modify operations in response to changing circumstances as the industry develops.
- Provide a cost effective and consistent framework for compliance monitoring and sanctions for non-compliance.
- Provide greater certainty about consent renewal or allow longer tenure.

Interventions:

- Identify all possible zones for open ocean salmon farms with appropriate growing conditions. Participants identify their preferences for water space within the identified zones and apply for consents.

  Using a zonal approach will streamline the consenting process, which should save applicants' time and money, and increase the likelihood of success.

- Identify all possible zones for open ocean salmon farms with appropriate growing conditions and allocate water space within zones to participants, who will then apply for consents.
- Identify all possible sites for open ocean salmon farms with appropriate growing conditions, obtain the necessary consents and allocate consented sites to participants.

  The research on the environmental impacts of open ocean salmon farming and optimal environmental conditions has not reached a stage where it would be possible at present to confidently identify optimal farming zones and spaces. Optimal in this context might include striking a balance between sustainability objectives and financial/commercial objectives.

  All the preceding interventions will require the Government to fund the necessary environmental and other research needed to enable the identification of the optimal zones and sites.
- Require participants to pay for access to/allocation of water space. Options include:
  - Upfront one-off payment or annual charge.
  - Set payment levels or let the market determine payment levels through some form of tender process.
  - If annual payments are used, provide for abatement of payments in early years to recognise that farms will need some relief as they are established and while production is ramping up to sustainable levels. This could involve relating annual charges to production, sales revenue or some combination.
  - If one-off payments are used, provide for deferment of a portion of the payment, again to recognise early-stage cash flow issues that farms will have to manage.

Issues:

- Government funded science and research to identify zones and sites will be in lieu of research that participants would have to undertake under the current resource consent process. The case for recovering the cost of this research would need to be considered – it could be part of the rationale for charging for access to water space.

  Alternatively, it might be considered as part of the Government's contribution to assist the industry achieve the growth challenge. It would have the added benefit of the Government exercising some level of influence or control over the sustainability of farming sites.
- How to determine the appropriate environmental limits and therefore potential size (production levels) of sites. It is likely this will need to be determined by first understanding the environmental limits then working back to estimate limits on feed/discharge, which will determine the level of production.
- How to match site locations with onshore facilities (infrastructure, hatcheries, processing facilities, support services).
- How to ensure site locations are efficient for individual participants. For example, for participants wanting more than one site, should the sites be contiguous to enable operating efficiencies in the utilisation of sea borne infrastructure and access to onshore facilities or is diversification of location to minimise operating risks from sea conditions, weather, biosecurity threats etc. a higher priority?
- Determination of an allocation model, which could address the previous issues. The water space payment options listed above would, if designed effectively, encourages participants to bid competitively for sites that they value the most. The model should include a weighted attributes approach to factor in non-monetary criteria such as innovation, providing advantages to new entrants, or other outcomes that are deemed desirable.
- The allocation model and any revisions to the consenting process need to be designed carefully so that they are no more and ideally considerably less onerous than the current consenting process.
- If the allocation model does involve participants paying to gain access to sites, then the pricing model might need to take into the account affordability and the considerable capital needed for site development and early-stage operations. Hence, the suggestion of abating the payments in early years and relating the access fee to production levels or deferring payment for a predefined start-up period.
- If the market is perfect, then the Crown should be indifferent to receiving an upfront payment for access to water space or a recurring charge over the life of the consent. What might be more pertinent for the

Government is how the two approaches to charging for access to water space might be interpreted. For example, an upfront charge could be interpreted as delivering some form of ownership right, whereas a periodic charge over the life of the consent is more akin to a temporary right to use the allocated space. This difference could be considered to a fine distinction, but perceptions will be more important than reality.

- The time required to design, implement and transition to a new consenting regime and process could be considerable.

Iwi participation

Objectives

- Provide Māori with opportunities to participate in open ocean salmon farming (in its widest sense) and so support Māori economic, social and environmental aspirations.
- Accommodate multiple forms of participation, recognising that different iwi may have different assets that they can bring to the industry (water space, capital, experience, and know-how) and want different forms of participation.
- Accommodate different participation in discreet components of the value chain.
- Recognise that motivations for and desired outcomes from participation may differ between iwi.

Interventions

- Provide information to Māori/iwi that explains the open ocean salmon farming value chain, the risks, benefits and potential, the capital needed, the development and operating timetables, the possible entry points and the probable need to partner with others that have or able to access the requisite experience and capability to develop and operate a successful open ocean salmon farm.
- Provide advisory services to Māori/iwi interested in participating to support decisions on whether to commit to participation, in what form, where in the value chain and when.
- Provide funding for development of site surveys, business plans, capital raising plans etc.
- Provide financing assistance if required to support Māori/iwi participation. This could be as a passive financier or as an active participant.
- Provide funding and other forms of assistance to Māori/iwi to:
    - Analyse the merits of multiple iwi joining together, for example on a regional basis, in a single structure that will:
        - Enable smaller iwi to participate and
        - Create an entity of some scale that can play a major role and derive benefits from the successful development of the industry. This could involve direct co-investment by the Crown.
    - Design an investment structure.
    - Develop a business case and capital raising plan.
    - Identify and assess possible partners and the form of relationship that will best suit all parties
    - Put the structure in place, raise the required capital and commence implementation.
- Provide financing assistance if required for the multi-iwi entity. This could be as a passive financier or as an active participant. It could be shorter term seed funding or a longer-term capital investment.

Issues

- Ideally, Māori/iwi will move quickly to organise their desired involvement in the industry, be it individually or jointly, to allow as much time as possible for establishment of the open ocean salmon farming value chain and to grow the business to the desired scale by 2030. There is a risk that opportunities for development will not exist for some iwi, and that it will not be practical for some iwi to move at the required pace.

Research

Objective:

- Produce targeted research that is directly relevant to and will help participants solve key practical issues that are barriers or hurdles to cost effective development and establishment of open ocean salmon farms.

  The research will encompass such things as adapting/modifying infrastructure technology from other countries to suit New Zealand conditions, operating methods to ensure fish health and welfare and optimal growth rates. Also, research is needed to further the understanding of aquaculture and environmental interactions in an open ocean environment. Lack of knowledge about these interactions is a significant barrier to the consenting process.

- Produce research that will assist participants continually enhance the sustainability of operations (both onshore and offshore).
- Produce research that will increase productivity of offshore and onshore operations.

Interventions

- Encourage research providers to work closely with industry to maximise prospects of commercialisation
- Facilitate and coordinate direct contracting between individual participants and CRIs on a user pays basis.
- Provide a contestable fund to be accessed by individual participants to be used to fund contracted research.
- Fund and/or direct CRI's to undertake research for the benefit of industry (i.e., not participant specific).
- Provide funding to the industry, to commission and receive research for the benefit of the industry. Research to be undertaken by parties with the relevant skills (i.e., not necessarily CRIs).
- Influence funding decisions about aquaculture-specific research.
- Facilitate bridging the gap between pre-commercialisation and commercialisation. For example, provide funding for space/facilities that can be used by research organisations for trialling.

Issues

- Sources of funding.
- The capacity and capabilities of CRIs to undertake specific, applied research.
- Ensuring that the intervention does not provide one or more participants with an unfair competitive advantage.
- Research outputs funded by the government are made available to the industry.
- Ensuring that any funding grants are used only for research and the research is directed at developing the industry to achieve the strategy objective.

Employing skilled migrants

Objective

- Ensure that the industry can employ/contract people who have aquaculture experience, particularly experience and knowhow/technical expertise in developing and operating open ocean salmon farms. These people will need to be recruited from overseas.

Interventions

- Partner with industry to identify skill needs and gaps and then provide mechanisms for the industry to employ people from overseas with the requisite experience and expertise to help accelerate the development of financially viable open ocean salmon farms. These skills do not feature on Immigration NZ's current long term and regional skills shortages lists.
- Remove immigration regulatory barriers to freedom of movement by skilled individuals.
- If COVID-19 persists and there is an ongoing need for isolation and quarantine by arriving visitors, facilitate the allocation of the necessary MIQ spaces or allow self-isolation or home-quarantine if this is feasible.

Issues

- Accessing offshore expertise will help participants establish farms and allied operations in a time and cost-effective manner. A benefit of the New Zealand open ocean industry lagging developments in Norway and Chile is learning from their experience and mistakes. An effective way of doing this is employing or contracting individuals who have "been there, done that".
- The requirement is for skills during the establishment and development phase. This is different to the need for an ongoing supply of labour with the necessary training (see below). The requirement may run counter to the Governments objective of reducing the seafood sector's use of migrant labour, which is the subject of the current "Ministerial Inquiry into the Use and Allocation of Migrant Labour in the Seafood Sector". The recommendations of this inquiry have not been released yet.

  Whether the need for experienced people from overseas will be a major "policy" issue will depend in part on the number of people needed, which is unlikely to be significant.
- Access to skilled labour is an issue across the primary sector and in other sectors, for example construction and building. Open ocean salmon farming will be competing with other industries for the skilled and trained labour needed to achieve its growth aspirations. Parties interviewed for this paper noted that they are managing staff shortages now and that insufficient labour could constrain future growth.

Skills development

Objective

- Develop a pool of labour that can work in all aspects of the industry.
- Maximise the benefit that local communities can leverage from development and growth of the industry.

Interventions

- Work with industry to identify potential employment and skills needs to enable profitable growth. This could link with the activities of the Aquaculture Workforce Group which is investigating skills shortages in the aquaculture sector and developing a plan to address the shortages.
- Minimise barriers to individuals gaining training and development relevant to the industry (for example, "learners must be employed in the seafood sector and must engage in training via their employer" to enrol in seafood programmes provided by the Primary ITO).
- Provide a range of training/education options that cater for different types of skills that will be needed in the industry (for example, work in a hatchery will be different to work in a processing plant which will be different to work on an open ocean salmon farm) and that will produce skills that are relevant to and required by the industry.[37]
- Ensure the skills development and training options are available in locations that will be of most use to the industry.
- Encourage training organisations to ensure there are no features or elements of their courses that discourage participation by sectors of society under-represented in the industry.
- Provide funding to enable the above interventions.

Issues

- There are private as well as public sector entities/organisations that provide seafood/fishing training. What means can be used to ensure private sector training organisations are able and willing to deliver training?
- If funding is required, what method will produce best value for taxpayers' money? Funding to:

[37] For example, Nelson Marlborough Institute of Technology Limited has a several aquaculture education and skills development courses but they do not cover all aspects of the industry.

- Individuals (could be in the form of student loan that may be repayable or not repayable subject to certain conditions). Provides individuals with freedom to choose where, when, and how they receive training.
- Training organisations, for example as per FTEs funding or the Targeted Training and Apprenticeship Fund (TTAF)[38].
- Industry participants, to assist with the cost of lower productivity as employees receive training.

These are not mutually exclusive options and there could be a combination of options.

Interventions to train and provide skills to New Zealanders is consistent with the Government's desire to reduce the aquaculture sector's use of migrant labour and will be important to the inclusiveness of industry growth.

Onshore facilities

Objective

- Develop onshore facilities[39] that will:
  - Have sufficient capacity at the outset to accommodate planned growth for the foreseeable future or be cost effectively scalable so that capacity can be added as the volume of salmon being produced grows over time.
  - Be operable in a manner that:
    - Optimises use of natural resources.
    - Produces minimal waste, which is disposed of in an environmentally sensitive manner.
    - Minimises the production of greenhouse gases.
    - Is cost effective and maximises operating margins.
  - Be adaptable and able to be efficiently modified to accommodate:
    - Technology advances that will happen over time.
    - Variations in product specifications, for example: variations in the time smolt are required to be kept onshore (increase weight); changes in product specifications (e.g., weight), packaging etc.
  - Be financed in a manner that assists participants manage investment risk. This could involve reducing the upfront capital participants will need to invest to develop onshore facilities while they develop, prove and then scale up their open ocean technology and production.

Interventions

- Provide funding to individual participants for development of business plans, capital raising plans etc.
- Provide financing assistance if required to support construction of onshore facilities. This could be as a passive financier or as an active participant.
- Provide funding and other forms of assistance to:
  - Analyse the merits of participants joining together to coordinate development of onshore facilities. This might involve developing one or a small number of larger facilities that can deliver economies of scale for all participating parties – in effect develop industry scale facilities as opposed to individual participants developing their own facilities, which could be smaller scale.
  - Design the ownership structure, contractual framework, capital structure and operating model for industry scale facilities.
  - Develop a business case and a capital raising plan.

[38] New Zealand Certificate Seafood Processing (L3) with strands in Fish and Fish Products, Live Holding, Cleaning and Sanitation, and Seafood Logistics is on the TTAF list of qualifications and programmes

[39] Primarily hatcheries and processing plants but could also include feed production facilities

- Put the structure in place, raise the required capital and commence implementation.

- Provide financing assistance if required for the industry scale facilities. This could be as a passive financier or as an active participant. It could be shorter term seed funding or longer-term capital investment.

Issues

- Assistance in whatever form provided to individual participants needs to be transparent and available to all participants on an equal basis. The assistance should not provide a competitive advantage to one participant relative to another because of favourable treatment. Competitive advantage or disadvantage will not be an issue where participants choose not to take advantage of the Crown's offer of assistance.

- There are several issues with developing industry scale facilities:
    - The facilities will need to be able to efficiently and cost effectively meet the varied needs of industry participants.
    - The first step in designing the ownership structure, contractual framework, capital structure and operating model will be to ensure that satisfactory contracts can be put in place that provide the participants with surety that their hatchery and processing requirements, including quality standards, will be met.
    - If satisfactory service contracts can be put in place, then the onshore facilities do not necessarily need to be owned or financed or operated by the participants. For example, a processing plant could be financed, owned, and operated by a party or parties not involved in the farming component of the value chain – the plant would operate as a contract or toll processor. Alternatively, facilities could be owned and financed by financial investors and operated by a third party or the participants.
    - Notwithstanding who finances and owns the facilities, the service contracts between the entity or entities operating the facilities and the participants should be arm's length contracts with market pricing for services and commercial terms and conditions.
    - Pricing structures will need to be transparent and ensure that participants pay the direct costs of servicing their requirements and a transparently determined share of joint costs.
    - It is not necessary for all components of the onshore part of the supply chain to be owned and financed by the party or parties. Hatcheries and processing facilities could be owned, financed, and operated separately.
    - The industry in New Zealand will be small by international standards, even at the scale needed to support the $3 billion revenue objective. Achieving scale benefits from onshore facilities will require a large proportion of participants to contractually commit to long-term usage of the facilities. Securing this commitment will be challenging, but not necessarily impossible:
        - Participants might consider some or all components of the onshore value chain to be strategically important to the nature and specification of their products and may want to control these components through developing and owning their own facilities. Vertical integration of most if not all value chain components is a feature of larger northern hemisphere salmon producers.
        - The participants will be competitors. It should not be surprising if they are hesitant about working together. The commercial/financial benefits of supporting industry scale facilities will need to be compelling. But if they are, and if the participants can be assured that their competitiveness and operating flexibility will not be compromised then the imperative to optimise costs and maximise cash flow should provide sufficient incentive to commit to an industry solution for onshore facilities.
    - Meeting industry processing or hatchery needs with single facilities will pose resilience risks – i.e., there will be a lack of sufficient redundancy to manage plant shut-downs for biosecurity, food safety, technical etc. reasons.

- Regulatory considerations, if any, with the industry joining together to support onshore facilities of scale will need to be addressed[40].

Onshore infrastructure

Objectives

- Offshore farms and onshore facilities are supported by infrastructure of appropriate capacity and quality. This infrastructure includes wharves, roads, energy and telecommunications networks and supply, water supply, wastewater collection and disposal and solid waste disposal.
- Participants planning farms and facilities and the agencies responsible for identifying and consenting open ocean sites have due regard to locating onshore and offshore activities where existing infrastructure can be used wherever possible.

Interventions

- Encourage farms and onshore facilities to be located wherever possible in areas with existing infrastructure.
- Instruct and fund a central agency to:
    - Review the alignment between existing infrastructure and the likely location of farms and onshore facilities. Identify existing infrastructure that can be used and new infrastructure that might need to be constructed or installed? This will need to consider potential locations for farms and facilities, the industry growth forecasts and the operational and financial implications of transport and logistics – for example, when does the distance between farm and wharf become uneconomic?
    - Prepare a stocktake of existing infrastructure and report on its condition and capacity, what needs to be done, if anything, and what will it cost to address any condition deficiencies and ensure that there will be enough capacity to support forecast industry production and processing activities.
    - Report on the cost of constructing or installing any new infrastructure.
    - Identify the specific public sector or private sector agencies/entities that are primarily responsible for the infrastructure (water and wastewater assets and solid waste disposal will be the responsibility of local government; wharves could be either local government or private sector owned and/or operated; electricity and gas distribution networks and electricity and gas supply will be the private sector; the private sector will own and operate telecommunications networks and provide the associated services).
    - Identify any plans that those responsible for the infrastructure have for refurbishing, upgrading and/or expanding existing infrastructure or building or installing new infrastructure. Assess whether the planned work will deliver infrastructure to the appropriate standard and capacity and, if not, what will it cost to do so.
    - Identify options for financing and ownership of new public sector infrastructure.

      The default assumption is that infrastructure is ordinarily provided by the private sector by way of services and that the participants and the infrastructure service providers will agree commercial arrangements for the provision of the necessary infrastructure services.
- Establish a fund that can be accessed by public sector parties to upgrade and or expand existing infrastructure. Conditions could include:
    - The funding is available only where existing infrastructure needs upgrading or expanding and the scope of the upgrades or expansion exceeds any existing plans for upgrade or expansion.
    - The funding will supplement and not replace any existing funds allocated for upgrading or expanding the infrastructure.

[40] Issues might include adequate consumer protection, a level playing field for competitors, including parties that might enter the industry in the future, market power is not taken advantage of for an anti-competitive purpose, there is not cartel behaviour and the extent of competition in a market is not substantially lessened by the participants agreeing to industry scale facilities.

- The funding will need to be repaid.
- The responsible party must consult with the participants, as users of the infrastructure, the Crown, as a funder and other users, if relevant on:
  - The design of the upgrades and expansions and their adequacy and appropriateness.
  - Charges for use of the infrastructure post the upgrades and expansion.

The Provincial Growth Fund and the New Zealand Upgrade Programme are examples of Government programmes that have been/are being used to fund infrastructure development/ refurbishment. For example, the New Zealand Upgrade Programme is providing a considerable proportion of the funding for the development of the Opotiki Harbour.

- Establish a fund that can be used to provide temporary assistance to participants that will be paying charges for new infrastructure to private sector providers.

Issues

- The impact on individual participants of upgrade or expansion of existing infrastructure or the development of new infrastructure will depend on the location of their farms and onshore facilities.
- Will likely require coordination with other sectors, where the infrastructure is shared or multi use.

Offshore farms

Objectives

- Successful establishment of enough farms of an appropriate scale within the required time frame to deliver the quantity of salmon products needed to support the $3 billion by 2030 objective.
- The farms are operated in a manner that has appropriate regard to use and disposal of resources, are sympathetic to the environments in which they operate, provide opportunities for local support industries and labour and ensures that the growth in the production of high-quality salmon will continue beyond the quantities needed for the $3 billion by 2030 target.

Intervention

- Reduce regulatory uncertainty (see above).
- Provide research and development support (see above).
- Provide support to access required skills and for training and education (see above).
- Provide support, including funding to individual participants for development of business plans, capital raising plans etc.
- Provide financing assistance if required to individual participants to support the development of the offshore farms and so accelerate the development timeframe. Financing could take different forms depending on the Government's investment objectives and the circumstances and characteristics of individual participants and their projects. For example, finance could be provided as equity, subscribing for shares, debt or grants, which may or may not be repayable depending on the achievement of certain outcomes, for example.

Issues

- Assistance in whatever form provided to individual participants needs to be made using a transparent allocation method that ensures fair and equitable treatment of all applicants for the assistance. The assistance should not provide a competitive advantage to one participant relative to another because of favourable treatment. Competitive advantage or disadvantage will not be an issue where participants choose not to take advantage of the Crown's offer of assistance.
- The benefits of scale in farming operations will not be as significant as it could be/will be for onshore facilities. Also, the design of farms and operating methods will be specific to individual participants. No doubt they will consider farm design and operation as crucial to achieving their goals for salmon farming and a source of competitive advantage, for example in terms of operating costs and product quality.

There will be limited or no scope for an industry wide approach to farming. The possible exception might be in relation to assets such as well boats, which will be expensive and may not of themselves confer competitive advantage.

Market development

Objectives

- Sustainable demand for New Zealand King salmon in export markets will be more than enough to absorb the growth in volume that will be needed to support the $3 billion by 2030 objective.
- Notwithstanding the substantial increase in volume, prices for New Zealand King salmon in export markets will be sufficient to at least:
    - Ensure that all participants in the value chain are financially viable. This means that revenue generated by the industry is more than sufficient to pay all operating costs and provide investors with the return they require on the capital they have invested given the investment risk they are bearing.
    - Incentivise participants to continue to grow production.
- Effective management of the risk of in-market pricing by participants that will erode the price premium that is needed to ensure long term industry viability.

Interventions

Industry market research, development and branding

- Scope the potential and options for:
    - An industry approach to researching and investigating the potential demand for New Zealand King salmon and international market opportunities.
    - The concept of adopting an overarching brand and brand strategy for New Zealand King salmon. Marketing of the New Zealand brand would include the promotion of product attributes that do not differentiate individual participants products or provide some form of individual competitive advantage. For example, the considerable nutritional benefits of New Zealand King salmon relative to Atlantic salmon and other sources of protein, the sustainability credentials of the New Zealand industry etc. Individual participants could promote and market their own brands, but they will be alongside or better still under the "New Zealand salmon" brand.
- Facilitate bringing participants together to develop a framework for, and agreement on, industry market research and the development of New Zealand King salmon branding.
- Provide funding to:
    - Develop strategies and plans for international market development and the New Zealand King salmon brand.
    - Produce New Zealand King salmon branding material and marketing collateral.
    - Undertake international market research and development activities.
    - Commence New Zealand salmon brand marketing and promotion activities.

  The case for the industry contributing funding for these activities will need to be considered, given that the most if not all the benefits are likely to be private rather than public. An option could be a model where the Government matches funding contributed by the industry. An example of this approach is the NZTE managed International Growth Fund, which is a co-investment programme that supports exporters develop opportunities in export markets

Industry marketing and selling

- Scope and develop options for coordination of all industry sales and marketing activities. This will require participants to relinquish their rights to branding, marketing and selling their own products and agree to all products from all participants being marketed, sold, and distributed under a single brand, probably by industry owned entity. This would be akin to single desk marketing and selling.

- Facilitate discussions with and among current participants and potential new entrants, including iwi that express an interest in entering the industry and other potential new entrants to the industry, about the feasibility and acceptability of a single desk approach.
- If a single desk approach is considered by all current and potential entrants to be a workable and preferred model, then
    - Determine and implement the legislative support needed to make it happen.
    - Provide the mandate and funding to the appropriate public sector agency to establish the sales and marketing entity. This could include putting in place a unit, with an unambiguous and precise terms of reference to undertake all activities needed to have the entity operational by an agreed date.

Issues

Industry market research, development and branding

- The objectives of industry market research, development and branding would be to:
    - Develop an informed view of the potential demand for New Zealand King salmon in current and possible new markets. Identify the factors that will affect pricing in key markets, with a particular focus on the potential to increase prices over time above current levels.
    - Recognise that increasing current exports of New Zealand salmon of approximately 5,000 tonnes to the 70,000 - 80,000 tonnes needed for the 2030 revenue objective will require a very considerable marketing effort. New Zealand exporters have been able to successfully open markets for their product. But increasing exports to 51,750 to 60,250 tonnes per annum will require marketing and market development resources at a different level to that currently deployed.
    - Recognise that export volumes of 51,750 to 60,250 tonnes of New Zealand King salmon is a very small quantity in terms of the global trade in Atlantic salmon, let alone other seafood products. New Zealand salmon will need to continue to be marketed in a way that differentiates it from Atlantic salmon and other seafood, without prompting an aggressive competitive response. This will be important because of the need to maintain the price premium that the industry needs to be commercial viability and to be recognised.

      A small number of companies are exporting salmon from New Zealand. New Zealand King Salmon Limited is the largest (but not the only) exporter. It has been able to open markets and sell product internationally but its volumes are very small – in 2019, the last non-COVID impacted year, it harvested approximately 7,900 tonnes and sold approximately 7,500 tonnes, of which 3,900 tonnes was exported.

      Exports of 51,750 to 60,250 tonnes is far more than current industry exports and notwithstanding the New Zealand industry's exporting successes to date.

Industry marketing and selling

- The industry marketing and selling option, the single desk model, would be challenging to design and implement:
    - It will require all participants, both current and future, to relinquish their individual rights to market and sell their products for the "greater good". They would need to be convinced that selling through a collective will yield better returns than each participant acting independently.
    - There could be a perception by the participants that they will be reduced to commodity producers as they will be giving up the ability to individually create ways to add value. Commoditisation is at odds with a product that is and will need to be presented to the market as a premium and nutritious food product.
    - Further to the previous point, New Zealand salmon is a product where there are value adding opportunities, more so than some other New Zealand food exports, such as apples or kiwifruit. For example, product form, (fillets, portions, sides, fresh frozen etc), secondary processing for smoking, slicing, flavouring etc. and packaging are all ways of influencing and satisfying customers' preferences and providing opportunities for selling at different price points.

Where in the industry marketing and selling model, these value-added processes should be undertaken will be an important issue. For example, should the industry adopt a dairy industry approach with an industry owned and controlled entity being responsible for all activities including processing after the fish are landed on the wharf? Or should individual participants be responsible for the value adding processes, and if so, how will consistency of product and presentation be assured?

- There will be a considerable number of operational and structural matters that will need to be formulated or addressed and agreed. For example, who has legal title to the product through the value chain – does it transfer from the participants to the marketing and selling entity at some point; who bears the in-market pricing risks; who bears the risk of product not meeting in-market quality standards or being rejected because of defects/deficiencies? How are net returns from sales and marketing allocated to participants? etc.

  These and the many other similar practical issues will likely be resolvable, but it may take some time to determine positions that are acceptable to all affected parties.

- Sales and marketing cooperatives have had a chequered history in New Zealand. The New Zealand Apple and Pear Marketing Board served the industry from around 1920. It had a statutory monopoly – New Zealand grown apples and pears could only be marketed through the Board. Increasing concerns about its performance led to growing calls for removal of its statutory monopoly, which occurred in 2001. The industry experienced volatility after deregulation as many entities entered the post-harvest and marketing part of the value chain and vied for market position and customer attention.

  The industry has since matured. Some of the smaller marketers did not survive and a small number of large, vertically integrated companies now dominate the industry. There would be little, and probably no appetite to return to a regulated model.

  On the other hand, the New Zealand Kiwifruit Marketing Board has retained an exporting monopoly, which is exercised by Zespri Group Limited.[41] Zespri has been successful in providing strong returns to New Zealand growers and through effective marketing and selling, careful ownership and control of its varieties (aside from the current issues with unlicenced growing of Zespri™ Sungold™ variety in China) and development of a pipeline of new varieties.

  Of course, there are successful food export industries that have not been subject to statutory backed single desk selling; mānuka honey and wine are two obvious examples.

  Mānuka honey is an interesting example in that there is no single desk exporting monopoly but there is a requirement for all honey labelled as mānuka for export to be tested by an MPI-recognised laboratory to make sure it meets the mānuka honey definition. The reason given for the testing requirement is[42]:

  The science definition for mānuka honey is essential to maintain New Zealand's premium position in overseas markets. It will also help the continued growth of our export honey industry. It's important:

  - *that overseas regulators have confidence in the assurances we give them about New Zealand mānuka honey*
  - *consumers in export countries are confident they're getting genuine mānuka honey.*

  If not, our access to markets could be put at risk or we may lose the premium prices our bee products command overseas.

  This is of interest to salmon farming as it demonstrates the need for authenticity to maintain a price premium. It is also relevant in the context of the significant dispute between New Zealand and Australian manuka honey producers over the right to use of the term 'manuka honey'. This has been brought to a head following the New Zealand Manuka Honey Appellation Society lodging a trademark

[41] The Kiwifruit Export Regulations 1999 establish Zespri Group Limited as the sole authorised exporter of New Zealand grown kiwifruit to all markets except Australia. However, the Regulations do provide for the export of kiwifruit, by others, under collaborative marketing arrangements subject to the appropriate authorisation to do so.

[42] https://www.mpi.govt.nz/food-business/honey-bee-products-processing-requirements/manuka-honey-testing/

request in several regions around the world, claiming manuka is a Māori name inextricably tied to New Zealand – similar to the term champagne is to a region in France.

- The “single desk” model is likely to be at odds with requirements in some trade agreements. The practicality of this approach would require careful consideration.

8. Evaluation of intervention options

Introduction

Individual interventions have been evaluated against a series of criteria. The criteria are described in Table 1 and the evaluation is presented in Table 2.

Observations

A key output from Table 2 is the prioritisation of the interventions. Several interventions have been assessed as high priority. Those that warrant initial attention are:

- Changes to the way consents are applied for and issued. There are several matters that need to be addressed to enable the industry to grow at pace and prosper. It is risky to assert that one issue is more important that all others but there was consistent feedback from the consultation for this paper that if there is one thing that the Government could do for the industry it should be to change the consenting process to provide greater certainty and timeliness of consenting application outcomes and greater operating flexibility under issued consents.

  It is appreciated and acknowledged that the changes to the consenting process will be complex and take time. The changes will need to be designed carefully to ensure that the overarching objectives for resource management are not compromised, due regard is given to the likely wide range of views about changes by stakeholders and that the risk of unintended consequences are minimised. However, it would be of considerable benefit if the Government were able to signal that it acknowledges the issues the current process causes for the industry and that the process to replace the RMA will factor in the need to make changes.

  What changes can be made to the process is being worked on by the Ministry. But there might be merit in having a model that involves:

  - The Government identifying zones where open ocean salmon farming can take place. This will require the Government to commission the science research needed to determine the environmental impacts of farming in the desired locations.
  - Tendering water space within the identified zones. The tender would likely be based on a multi criteria assessment, requiring tenderers to be specific about how they will ensure sustainability, productivity, inclusiveness and resilience. An important component of the tender should be a "price" for occupying water space. Whether this should be an upfront payment, payments to made over time (which could be linked to production or sales to reduce the burden in early years) or some combination thereof will need to be determined.

  Whether the tendered water space can be or should be consented by the Government or whether the consenting will be the responsibility of the successful tenderers will depend in part on how the consenting process will work in the RMA replacement legislation.

- Working with iwi to facilitate their involvement in the industry will deliver several benefits. Assisting iwi exercise their kaitiakitanga and rangatiratanga through a meaningful stake in the industry from the outset will go some way to deliver economic development goals and in assisting in realising the potential of the Māori economy. It can also contribute to discharging the Crown's obligations under the Settlement Act.

  The first step will need to be engagement and discussion with Māori/iwi to explain what involvement in the industry will entail and then, importantly, to gauge the level of interest and the form of involvement. In this regard it is likely that there will be a range of views and aspirations among iwi about the level and nature of their involvement. The Government will need to be prepared to provide various forms of assistance.

  One model for involvement that may be applicable is an entity that will accommodate multiple iwi investment. This could also possibly include the Crown as a co-investor. The early stages of the development of the industry will be relatively high risk. A vehicle that accommodates multi-iwi investment will help individual iwi optimise their exposure to industry development risks while at the same time ensuring that there is sufficient capital available to create a business of meaningful size.

- Research and development will be needed, and is being carried out by participants, to determine the technical feasibility of selected farming infrastructure and methods. A lot of this research is needed upfront because it will determine the way farms are designed and to be operated.

The need for research to be focussed on the specific requirements of the industry and individual participants and achieving this through industry and/or participants contracting directly with research providers was a common message during the consultation process. Another theme was the need for specialist facilities to enable research – for example tanks that will accommodate onshore trials of infrastructure and farming methods and open ocean water space to undertake real life trials – and appropriate capability and enough capacity within research providers to deliver the required research.

Suggested interventions are:

- Provide a mechanism that will enable individual participants and/or the industry to contract directly with research providers, with the cost of the research being funded from existing science and research funding or from new funding.
- Provide funding for the development of research facilities and for capacity and capability. Again, this could be from existing funding or from new funding.

- Although open ocean salmon farming is a new farming method globally, there are people in other countries that will be developing knowledge and experience about what works and what are the pitfalls to avoid. It would be beneficial for the New Zealand participants to be able to engage such people to learn from others mistakes and understand what is considered to be best practice. It would be unfortunate if the New Zealand industry made mistakes during its establishment phase that could have been avoided but for seeking advice from those that have "been there, done that".

  Minimising if not removing regulatory barriers to employing/engaging skilled people from overseas will be beneficial. This may require resetting immigration regulations to accommodate the specific requirements of the industry for freedom of movement of skilled migrants being employed in the industry. Also, there will always be an immigration process to be complied with but streamlining this to minimise regulatory delays will be helpful.

- There is a case for interventions to assist the industry with market research and development early in the industry's growth to ensure markets are available to absorb the planned increase in volume at premium prices. This may be an extension of services already provided by New Zealand Trade and Enterprise.

  The concept of an overarching New Zealand King salmon brand is also worth exploring with the industry. This would not preclude individual participants marketing and selling under their own brands but it would provide country of origin and product assurance to consumers. In the first instance it will require consultation with the industry to determine if it has merits and whether there would be buy-in to the concept from most if not all participants. The value of the concept will be diminished if some major producers choose to not to participate.

Evaluation tables

Table 5 Intervention evaluation criteria

Criteria	Description	Rating
Implementation Complexity	How complex will the intervention be to implement?	High, medium, low
Funding or Direct Investment	Whether the intervention will require the Government to fund an entity or organisation (be it a central government, local government or private sector entity) or will it involve the Government investing. Funding implies that the money will not need to be repaid. Investment, on the other hand, assumes the Government will earn a rate of return on the investment and the investment will be repaid over time. The investment could be in the form of debt (a loan to the entity) or equity i.e., shares or some form of hybrid of these two principal forms of investment.	F (funding) or DI (direct investment)
When needed	Will the intervention be needed in the short term or is it less time critical and can be delayed until the medium term?	ST (short term), MT (medium term), LT (long term)
Impact	This is an assessment of the impact that each intervention will have on the development of the industry and achievement of the Roadmap objectives of sustainability, productivity, inclusiveness and	High, medium, low

Criteria	Description	Rating
	resilience. The assessment is whether the intervention will have a considerable (high) impact or less so (medium or low impact).	
Duration of benefits	Will the benefits resulting from the intervention be enduring or will they have a finite life? Assessing whether benefits will be enduring or finite is a fine distinction as any intervention that will contribute to the successful establishment of the industry can be said to provide enduring benefits.	ST (short term), MT (medium term), LT (long term)
Influence over outcomes	This is an assessment of the extent to which the intervention will enable the Government to influence the intervention outcomes. The assumption is that Government will want some assurance that its interventions will deliver results in terms of meeting the Roadmap objectives. As a generalisation, it is assumed that interventions involving funding might provide less influence than interventions involving investment. Funding implies providing other parties with resources to undertake specified activities. Investment can enable ongoing Government involvement. Being a provider of capital can confer a degree of direct influence and control. This distinction may not always be the case as there might be conditions attached to funding, for example monitoring and reporting requirements; staging the provision of funding where providing a tranche of funding is dependent on meeting predefined performance milestones; requiring repayment of funding if milestones are not achieved or funding must be repaid unless milestones are achieved.	High, medium, low
Strategy objectives.	Not all interventions will contribute to all Strategy objectives. An assessment has been made of the relationship between each category if intervention and the four Roadmap objectives	S (sustainability), P (productivity), I (inclusiveness), R (resilience)
Priority	This is an assessment of prioritisation of the interventions; that is the interventions that the Government could focus on initially. This is a subjective assessment based on the following criteria: • Ease of implementation. • The most immediate needs of the industry. • High impact. • Strong alignment with the Roadmap objectives.	High, medium, low

Table 6 Intervention evaluation

Intervention	Implementation Complexity	Funding or Direct Investment	When needed	Impact	Duration of benefits	Govt. Control of Benefits	Roadmap objectives	Priority
Resource consenting							S/P/R	H
Identify all possible zones for open ocean salmon farms with appropriate growing conditions. Participants identify their preferences for water space within the identified zones and apply for consents.	High	F	ST	High	LT	High		L
Identify all possible zones for open ocean salmon farms with appropriate growing conditions and allocate water space within zones to participants, who will then apply for consents.	High	F	ST	High	LT			H
Identify all possible sites for open ocean salmon farms with appropriate growing conditions, obtain the necessary consents and allocate consented sites to participants.	High	F	St	High	LT			H
Require participants to pay for access to/allocation of water space	High	F	St	High	LT			H
Māori/iwi participation							S/I	
Information to fully inform Māori/iwi about the open ocean salmon farming value chain, the risks, benefits and potential, the capital needed, the development and operating timetables and the possible entry points.	Low	F	ST	High	LT	High		H
Advisory services to support decisions on participation.	Low	F	ST	High	LT	High		H
Funding for assessing, designing, developing and establishing one or more multi-iwi participation entities.	High	F	ST	High	LT	Med		H
Financing to support individual or multi-iwi participation entity.	Med	DI	ST/MT	High	LT	Med		M
Research							S/P/R	
Encourage research providers to work with industry to maximise prospects of commercialisation.	Low	F	ST	High	LT	Low		H
Enhance direct contracting between individual participants and CRIs on a user pays basis.	Low	F	ST	Med	LT	Low		
Contestable fund to be used by individual participants to fund contracted research.	High	F	ST	High	LT	Low		M

Intervention	Implementation Complexity	Funding or Direct Investment	When needed	Impact	Duration of benefits	Govt. Control of Benefits	Roadmap objectives	Priority
Fund and direct CRI's to undertake industry-good research.	Med	F	ST	Med	LT	Low		H
Fund the industry or individual participants to commission industry-good research.	High	F	ST	High	LT	Low		L
Influence funding decisions about aquaculture-specific research.	Low	N/A	ST	Med	LT	Low		H
Facilitate bridging the gap between pre-commercialisation and commercialisation.	Low	N/A	ST	Med	LT	Low		M
Employing skilled migrants							S/P	
Partner with industry to identify skills needs and gaps.	Low	F	ST	High	MT	High		H
Minimise regulatory barriers to freedom of movement by skilled migrants.	High	N/A	ST	High	MT	High		H
Support industry efforts to locate and employ skilled migrants.	Med	F	ST	High	MT	Med		H
Minimise barriers to skilled migrants with employment arrangements entering the Country if COVID-19 persists (e.g., access to MIQ spaces).	High	F	ST	High	ST	High		H
Skills development							P/R/I	
Identify potential employment and skills needs for the future industry.	Low	F	MT	Med	LT	High		H
Minimise barriers to individuals gaining relevant training and development.	Med	N/A	MT	High	LT	High		H
Ensure there is a range of training/education options.	High	F	MT	Med	LT	High		H
Ensure skills development and training options are available in appropriate locations.	High	F	MT	High	LT	High		M
Onshore facilities[43]							P/S/R	
Funding for development of business plans, capital raising plans etc.	Low	F	ST	Med	LT	Low		M
Financing assistance for construction of onshore facilities.	High	DI	MT	High	LT	High		L
Funding and other forms of assistance for assessing, designing, developing and establishing an industry owned entity to develop industry scale facilities.	High	F	MT	High	LT	Low		H

[43] Primarily hatcheries and processing plants but could also include feed production facilities

Intervention	Implementation Complexity	Funding or Direct Investment	When needed	Impact	Duration of benefits	Govt. Control of Benefits	Roadmap objectives	Priority
Investment in industry scale facilities.	High	DI	MT	High	LT	High		L
Onshore infrastructure							P/R	
Encourage location of farms and onshore facilities near existing infrastructure.	Low	N/A	MT	Med	LT	Low		L
Investigate and report on:	Low	F	ST	Med	LT	High		H
• Location of existing infrastructure and the likely location of farms and onshore facilities.								
• A stocktake and condition assessment of existing infrastructure.								
• Cost of constructing or installing any new infrastructure.								
• The public sector or private sector agencies/entities with primary responsibility for infrastructure and any plans for refurbishment, upgrade and/or expansion of existing infrastructure or building/installing new infrastructure.								
• Assess if planned work will deliver infrastructure to the appropriate standard and capacity and, if not, what will it cost to do so.								
• Options for financing and ownership of new public sector infrastructure.								
Funding that can be accessed by public sector entities to upgrade and or expand existing infrastructure.	High	F	MT	High	LT	Med		M
Funding to be used to provide temporary assistance to participants paying charges for new infrastructure to private sector providers.	Med	F	MT	Med	ST	High		L
Offshore farms							S/P/R	
Reduce regulatory uncertainty (see above).								H
Research and development support (see above).								H
Support for employing skilled migrants and for training and education (see above).								H
Funding and support for development of business plans, capital raising plans	Low	F	ST	Med	ST	Low		M

Intervention	Implementation Complexity	Funding or Direct Investment	When needed	Impact	Duration of benefits	Govt. Control of Benefits	Roadmap objectives	Priority
etc.								
Financing assistance to support the development of the offshore farms.	High	DI	ST	High	LT	Med		M
Market development							P	
Industry market research, development and branding.								
Research to develop an understanding of potential demand and in-market pricing.	Low	F	ST	High	LT	Med		H
Work with industry to scope the potential and options for:	Low	F	ST	High	LT	Med		H
An industry approach to developing international market opportunities.								
An overarching brand and brand strategy for New Zealand salmon.								
Facilitate cooperation and coordination among participants to enable industry market development and New Zealand salmon branding.								H
Provide funding to:								
Develop strategies and plans for international market development and the New Zealand salmon brand.	Low	F	ST	Med	LT	Med		H
Produce New Zealand salmon branding material and marketing collateral.	Med	F	ST	High	Mt	Low		M
Undertake international market development activities.	Med	F	ST	High	LT	Low		M
Commence New Zealand salmon brand marketing and promotion activities.	Med	F	ST	High	LT	Low		M
Industry marketing and selling								
Scope and develop options for coordination of all industry sales and marketing activities i.e., a single desk model.	Low	F	ST	High	LT	Med		L
Facilitate assessment by the industry, both current participants and potential new entrants, of the feasibility and acceptability of the single desk model.	Med	F	ST	High	LT	Med		L
If the single desk model is considered by the industry to be a workable and								L

Intervention	Implementation Complexity	Funding or Direct Investment	When needed	Impact	Duration of benefits	Govt. Control of Benefits	Roadmap objectives	Priority
preferred model, then								
Determine and implement the legislative support needed to make it happen.	High	F	MT	High	LT	High		L
Provide the mandate and funding to the appropriate public sector agency to work with industry to establish the sales and marketing entity.	Med	F	MT	High	LT	Med		L

9. Delivery of Government intervention

215. The forms of Government intervention can be summarised as:

Regulatory change

216. This could involve changing how resource consents might be provided, their tenure and how ongoing compliance with consent conditions is monitored and managed.

217. Regulatory change will be complex and could take some time to design and implement.

218. Marine aquaculture is mainly managed under the Resource Management Act 1991 (RMA). This includes management of resource consents for open ocean salmon farms. As noted earlier, issues with obtaining and operating within resource consents are a primary concern for parties looking to establish open ocean salmon farms.

219. The Government is currently in the process of implementing plans to repeal the RMA and replace it with three new pieces of legislation. The primary replacement legislation is the proposed Natural and Built Environment Act. This is expected to be passed into law before the end of the current parliamentary term.

220. In the meantime, the Ministry for Primary Industries alongside other agencies is undertaking a review of the processes for obtaining and managing resource consents for marine farms and developing options for changes that could assist with achieving the Roadmap's objectives, among other things.

221. Any changes from the RMA reform and/or the work being undertaken by the Ministry on resource consenting that might impact on the interface between government, in its widest sense and participants is unlikely to warrant the establishment of new entity. However, there are some options for changes that will involve new activities. For example, there are options for how consented water space might be allocated to participants and charges levied for access to water space.

222. These new activities are unlikely to be substantially different to regulatory functions carried out by the public sector for other industries. They could be delivered through an existing agency or through a new entity. Critical to the decision to establish a new entity would be relative size of the new activities (how much resource and direct costs will be required to undertake the activities on an ongoing basis), what it will cost to establish and monitor a new entity (indirect costs), and the whether the nature of the substantive functions warrant the creation of a new entity.

Enhancing knowledge and information

223. This is Government funding public sector agencies, third parties and/or participants themselves to develop or enhance information, knowledge, and expertise to reduce the risks and uncertainties participants will face in developing a successful offshore farming industry.

224. It is not immediately obvious that delivery of this form of intervention will require a new entity. Some of the interventions might involve existing programmes and /or their delivery will be aligned with activities and functions of existing government entities. Some may be new but whether they will involve a level of activity and have a substantive function so different to one or more existing entities to justify the establishment of new entity is questionable.

Direct investment

225. This the Government investing in parts of the value chain, as either a passive financier or active investor. The rationale for investment will include:

- Participants are unable to fully finance development of farms because private sector investors take a risk averse view of what is a new and unproven venture.
- In the absence of Government intervention, the industry will develop but at a pace that is not consistent with the Roadmap's objective of a considerable acceleration in revenue growth. Intervention in this circumstance could require investment in assets and facilities that will have excess capacity initially. This will reduce the amount of capital that participants need to raise and reduce the risk to them and/or other private investors/financiers of investing in capacity in advance of the need for the capacity being proven.

226. Direct investment, in whatever form, will require the design of several processes and procedures to support the making of investments in the first instance and then managing and monitoring the investments on an ongoing basis.

227. It is likely that some if not all these investments will be commercial in nature – they are more likely to be loans, requiring repayment at some point, or equity investments as opposed to grants or similar funding. They will be better suited to being managed or administered by an entity with more of a commercial focus than a core government entity. Whether a new entity is required will depend in part on the number and complexity of the investments. If there is likely to be few and they are not overly complex then the costs of setting up, operating and managing a new entity may not outweigh the benefits.

228. There is a wide range of central Government entity forms. Four factors will be important to determining the form to be adopted for directs investment in the industry are:

- Commercial focus: The forms appropriate for Government investment will be those that are consistent with having commercial functions. In providing capital the Government will be investing in commercial businesses. These investments should mostly be on commercial, market terms. However, even if they have terms that are more advantageous than market terms, the investments should be managed using strong commercial disciplines.
- Governance requirements: This is the governance arrangements that the Government will require and, in particular, the degree to which Ministers need to give specific direction to the entity. For example, Ministers may want to direct the entity to make investments in or with certain participants. An obvious example is the entity could be charged with investing to ensure appropriate Māori involvement in the industry.
- Functions: What will the entity be required to do? For example, it could be capitalised by the Government and then given a mandate to receive applications for investment from participants, assess the applications, decide which opportunities to invest in, negotiate the investment terms, invest and then manage/monitor the investments on an ongoing basis. This is similar to how Crown investments in irrigation schemes were made and managed by Crown Irrigation Investments Limited.
- Debt and/or equity investments: If the Crown owns shares in an entity then the extent of its shareholding will influence whether it comes within the ambit of the machinery of government legislation or not.

229. If there is likely to be a sufficient volume of investments and transactions that will require ongoing management and monitoring to justify the need for a new, dedicated entity then the entity form should enable and strongly support a commercial focus and functions. Those entities that are compatible with commercial functions fall into two groups:

- Entity to operate as a business, but the Crown can specify additional policy objectives:
    - Crown entity company in those circumstances where there will be always 100% Crown ownership (e.g., Crown Irrigation Investments Limited, Television New Zealand Limited).
    - Public Finance Act (PFA) Schedule 4A company where the primary intent is that the Crown will always control the company, which usually requires owning 50.1% or more of the voting shares (i.e., owning a majority of the shares on issue) with the possibility of third-party minority ownership and it is not publicly listed (e.g., Crown Infrastructure Partners Limited),
- Entity's principal objective is to operate as a successful business:
    - State- owned enterprise (SOE) where there will be always 100% Crown ownership (e.g., Airways Corporation, New Zealand Post).
    - Mixed ownership model company (PFA Schedule 5) where there will be always majority Crown ownership, and so controlled by the Crown. The only mixed ownership companies at present are the three generator/retailers (Meridian Energy Ltd, Genesis Energy Ltd and Mercury NZ Limited), whose shares are publicly traded on the New Zealand Stock Exchange.

230. Examples of possible structures for Crown investment are included in Appendix B.

Principles for Government direct investment

231. The financial risks of direct investing are an important consideration that will have a bearing on the nature and form of the investment and the contractual requirements. The following is a suggested list of principles or requirements that the Govrenment might consider before deciding to invest:

- Only invest in individual developments that:

- Will assist in delivering the aspirations of iwi for involvement in the industry.
- Fully embrace its sustainability and inclusiveness goals, which sit alongside and are integral to the 2030 revenue objective.
- Require Government support only to assist with reducing the technological and biological uncertainties and to accelerate their growth plans. These participants are more than likely to be financially viable without Government support but with a growth profile that will not produce the volume needed for the 2030 objective.
- Have comprehensive and well researched business planning documents and evidence that the participant has or has sound plans to obtain the expertise, technology and other resources needed to successfully execute its development and operating plans.

- Consider the relative levels of private and public benefits.

- Be risk averse.

- Be comfortable that all cost-effective sources of equity and debt finance have been exhausted before investing. The terms and conditions for Crown investment should reinforce the incentives on participants to exhaust all other investment sources first. The Government should not be the first source of financial support.

- Look to exit when financial viability on commercial terms has been or can be achieved. The Government will not be a long-term investor unless there are specific policy objectives that might require a longer-term investment horizon. Withdrawing and recycling capital is an important principle underpinning the Government's willingness to invest. The terms and conditions for the Government investing will include specific details of the timing and the mechanism for its exit.

- Require a return on the capital it is investing commensurate with the investment risk it is bearing but taking into account that that primary objectives of investing is to facilitate timely industry growth that will further the Governments objectives for economic development, including Māori economic development, inclusiveness, sustainability and resilience. The Government will not be investing purely to generate a return on its capital, but this should not disincentivise participants from taking every opportunity to maximise returns to the Government.

- Be prepared to trade-off rate of return with achievement of its policy objectives so long as the level of risk it will be bearing is not excessive given its required rate of return. Every opportunity must be taken to minimise risk for the Government consistent with its position as a risk averse investor.

- Do not tolerate other investors achieving returns above commercial rates of returns while it remains an investor. Any cash representing returns above commercial returns should be used to accelerate the Government's exit from the investment. It should not be used to pay investors returns above commercial levels.

- Expect and demand high quality governance in all respects. It will require boards of directors to have appropriate competencies and reflect the diversity of industry stakeholders. It may require governance rights, such as the right to appoint a certain number of directors to the board, depending on the size and nature of its investment.

- Require a high level of disclosure, transparency and reporting subject to any regulatory obligations that participants may have about what information can be disclosed, to whom and when, for example stock exchange listed companies have specific information disclosure obligations and requirements.

- Provide its financial support in stages as research and development progresses and confidence about commercial viability increases.

- Invest with the expectation that it will not need to contribute additional capital over and above the investment requirements quantified prior to it agreeing to invest.

- Structure and provide investment in a manner that avoids any perceptions that the Government is subsidising developments to provide private benefits to certain stakeholder groups.

- Require operational risks to be allocated appropriately and comprehensively through sound, commercial contracts with customers and suppliers.

- Require financial risks to be allocated appropriately and comprehensively through sound, commercial agreements and arrangements with both debt and equity financiers.

- Only invest alongside reputable parties with appropriate financial capability and capacity. The Government will require certain rights of approval in relation to exit of existing investors and entry of new investors.

- Require mechanisms to incentivise appropriate parties to "step in" in the event of financial or operational difficulties[44].

[44] For example, it may require parent company guarantees of financial and operational support where the salmon farming operations are being undertaking by a subsidiary of a larger group.

Appendix A Land-based salmon farming

232. The focus of this paper is on open ocean salmon farming. However, the potential for land-based salmon farming needs to be recognised[45].

233. As the name suggests, land-based farming involves growing salmon to market-ready weight in facilities located on land, as opposed to in the ocean (either inshore or in the open ocean). There are two technologies used in these facilities: recirculating aquaculture systems (RAS) or the more traditional flow-through systems (FTS).

234. Both systems require flowing water to mimic the natural conditions needed for salmon to survive and thrive. RAS reuses water in the production process. Mechanical and biological filters and associated treatment processes are used to screen out effluent and restore water quality so that it can be recirculated to the salmon growing tanks. Proponents for RAS point to its low water usage, and consequently low wastewater discharge as an important environmental benefit.

235. In an FTS, water either flows by gravity or is pumped through the growing tanks or pens with minimal treatment of effluent waters. Unlike RAS, FTS require constant water exchange – a constant flow of fresh (i.e., "new") water as there is no recirculation. Incoming and outgoing water can be filtered to manage water quality.

236. RAS minimise exposure to external environmental factors that typically affect farming in the ocean. Almost all the factors critical to the fish growing conditions can be controlled, including fish health, water temperature, oxygen levels and even daylight. This enables optimal growing conditions to be maintained with relative stability, which contributes considerably to optimising fish quality, growing time, mortality rates, operating efficiencies and output volumes.

237. FTS can provide similar benefits depending on location and how it is structured and housed.

238. Containing farming activities within land-based facilities removes them from the marine environment and so concerns about the negative impact of salmon farming on the natural environment are reduced[46]. It also means that the location of the growing activities need not be confined to areas where the natural environment provides appropriate growing conditions.

239. In theory, land-based farms can be located anywhere so long as there is sufficient water, the ability to dispose of wastewater and supporting infrastructure and services. Importantly, there is the opportunity to locate farms close to customers and markets. This must be a significant advantage of this form of fish farming. It adds further to the sustainability credentials by minimising the physical distance between production facilities and customers and so reduces transport emissions (and costs). It also cuts down the time taken to move stock from farms to processing plants to customers, which increases options for supply of fresh as opposed to frozen product.

240. While the potential benefits of land-based salmon farming are considerable, it is in its infancy and there are significant technical challenges that need to be resolved before it can be considered a viable alternative to ocean farming. There are many companies, primarily in the northern hemisphere either planning to develop land-based facilities or have plants in operating mode. The successes of the latter are very mixed. There have been some high-profile failures and production volumes are very small.

241. The cost of developing land-based facilities is considerable and sourcing the substantial capital needed to finance plants is challenging given that the ability of the technology to reliably produce quality product at scale is unproven. Several companies developing facilities have raised capital through public share offerings. Investors were initially attracted by the prospect of high returns but their enthusiasm has abated of late and share prices have fallen as the operating and technical challenges have become apparent.

242. Providing the right biological conditions in the water is one of the most important technical challenges, particularly with RAS. It is apparent that controlling this with sufficient precision is not easy. Sub optimal conditions can have serious consequences – there have been instances of mass mortalities where conditions have been out of kilter. Less than ideal water conditions can also taint the flavour of fish.

---

[45] Mt Cook Alpine Salmon produces its salmon using a form of land-based farming, using. It operates a flow through system, using water diverted from hydro canals. All smolt (juvenile salmon) produced in New Zealand are grown in land-based RAS or FTS.

[46] There may continue to be concerns about water usage and discharge of wastewater. This will be more of an issue for flow through systems than recirculating aquaculture systems.

243. While the challenges to ensuring that the technology and operating models produce an environment conducive to growing healthy salmon are considerable, the drivers and incentives for persevering and innovating to make land-based farming a success are strong. It is fair to say that all ocean salmon farming regions are facing increasing pressure over the impact of farming on the natural environment[47] – the social licence to operate cannot be taken for granted. Also, the environmental and commercial benefits of locating farms close to major centres of demand for the product are strong.

244. Assuming land-based salmon farming can be developed into a financially viable operating model of sufficient scale, its relationship with current farming methods will need to be determined. It is not clear that it will necessarily replace ocean farming. It may be that both ocean and land-based farming can operate together, complimenting each other. But in the end the market, i.e., consumers will determine what role it plays in the supply of salmon and fish protein more generally. Factors such as acceptance of what will in essence be factory-farmed fish, taste and quality, pricing and environmental benefits will impact on how demand for land-based farmed salmon will evolve

245. For New Zealand, land-based salmon farming is both an opportunity and a threat. The environmental benefits are just as important here as elsewhere in the world. But perhaps the greatest opportunity is the ability to locate farms close to demand and so eliminate the disadvantage of being a long way from the markets. Of course, this would run counter to the objective of growing the industry with greater inclusiveness.

246. Almost all the land-based facilities being planned or in operation are for producing Atlantic salmon. Whether New Zealand King salmon can be produced profitably in land-based farms using RAS technology in particular is unknown. However, it is of interest to note that Sealand Advanced Aquaculture is producing King salmon from a RAS facility in Patagonia, Chile. Its volumes are very small. It is forecasting to produce over 100 tons in the next 12 months and increasing production to 500 tons by 2024[48].

247. Notwithstanding the small volumes, Sealand Advanced Aquaculture demonstrates that the land-based farming of Chinook may be feasible, which raises the issue of the competitive threat for the New Zealand industry. If New Zealand King salmon can be produced in large quantities in land-based farms, then it is entirely possible that competitors will build facilities in key markets that are being served by New Zealand producers now or might be targeted in the future. The ability of such farms to produce salmon of a similar or better quality than New Zealand salmon and at a comparable or lower cost is unknown. But the potential for this combined with the environmental benefits of land-based farming could be detrimental to the long-term prospects for the New Zealand industry.

248. In summary, land-based farming is currently a risky proposition. It is at an early stage of development. It is not the answer to growing the New Zealand salmon industry in the short to medium-term[49]. However, it would be in the interests of the industry to closely follow developments elsewhere, with a view to moving quickly to adopt the model to some degree if it proves to be viable. This begs the question of whether there is a need for some level of public good exploratory research into the relative advantages and disadvantages of RAS and FTS (it may that both have their place in a portfolio of production methods) and the feasibility of producing New Zealand King salmon in land-based farms, particularly RAS farms.

---

[47] "*Argentina's southernmost province has banned the use of intensive open-net salmon farms due to serious concerns about the impact the large cages, which can each contain tens of thousands of fish, could have on the marine environment and local economy. … The open-net farms are the same type used to farm salmon around Scotland, Norway, Canada and Chile, all of which are battling major environmental issues caused by intensive salmon production, including sea lice infections which have heavily impacted remaining wild populations, and huge algal blooms which have killed millions of fish.*" independent.co.uk/climate-change/news/argentina-salmon-farming-ban-environment-b1880503, Thursday 08 July 2021

[48] https://www.fishfarmingexpert.com/article/chilean-ras-farmer-making-first-king-salmon-harvest/

[49] The February 2020 Open Ocean Finfish Aquaculture: Business Case produced by Envirostrat Ltd for New Zealand Trade and Enterprise noted that "*RAS systems are unlikely to be an effective solution in New Zealand as the cost of the systems will be high, and one of the offsetting costs is by locating these systems close to the market to reduce costs and time associated with moving fish to the end customer. …. Growing fish in OOA systems is likely to have a significant payback in terms of fish health benefits … as well as creating greater scale in the sector. This type of approach would allow New Zealand to continue to claim more 'natural' farming rather than very high density on-land RAS systems, providing an advantage in competitive international markets*."

Appendix B Investment structures

249. Three options for the structure of Government investment are illustrated in Figure 3:

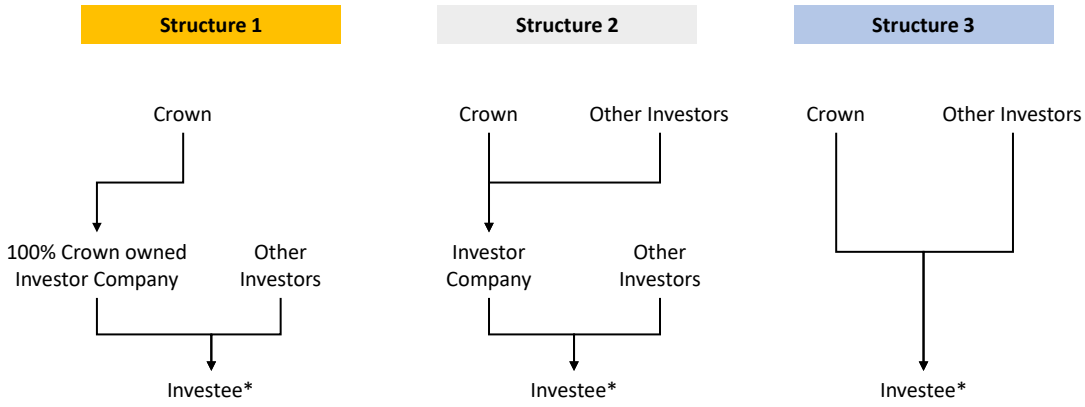
- Structure 1: The Government establishes a company, which it owns 100%. That company then invests into the industry as appropriate. The options for the form of the investor company are:
    - Crown entity company.
    - SOE.

  The form of the investee will depend on whether the Government (the Crown) is subscribing for shares or providing debt finance only. If the Crown investor company is subscribing for shares and the investee will be owned 100% or controlled by the Crown investor company then it will mirror the form of the parent company. If the investee is not controlled by the Crown either because the Crown investor company will not hold sufficient shares to exercise control or it is providing debt finance only then the investee will be company established pursuant to the Companies Act 1993 and will have no special status within the machinery of government.
- Structure 2: The Government invests in a company, alongside other investors which then invests into the industry. Similar to Structure 1, the form of the investor company will depend on whether the Crown is making an equity investment and subscribing for shares and if it is, whether its investment gives it control:
    - If there will be majority Crown ownership of the investor company at all times and so the Crown will always control the company: Public Finance Act (PFA) Schedule 4A company or a mixed ownership model company.
    - If the Crown will own less than 50% of the investor company and does not control it or has no ownership interest as it is providing debt finance only: limited liability company established pursuant to the Companies Act 1993 (i.e., not a company with any standing in the machinery of government)

  If the investor company is controlled by the Crown and the investee is a subsidiary of the investor company then the form of the investee will follow the form of the investor company. If the investee is not a subsidiary of the investor company then it will have not be a company with any standing in the machinery of government.
- Structure 3: The Crown invests directly in the industry (i.e., not through an intermediate company). If the Crown makes an equity investment in the investee and there are no other equity investors (i.e., then the Crown owns 100% of the shares on issue) the investee will be either a Crown entity company or an SOE (as for Structure 1).

  If there are investors with an ownership interest in the investee, then determination of its form will be the same as described for the investor company in Structure 2.

Figure 8 Investment structures



* The Investee will be some part of the value chain. It could be an offshore farm, processing plant, hatchery or some combination

Appendix C Important notice

This Report has been prepared solely for the purposes stated herein and should not be relied upon for any other purpose.

The Report is strictly confidential and (save to the extent required by applicable law and/or regulation) must not be released to any third party without consulting the author.

To the fullest extent permitted by law, Two Two Eight Limited does not accept a duty of care to any third party in connection with the provision of this Report and/or any related information or explanation (together, the "Information"). Accordingly, regardless of the form of action, whether in contract, tort (including without limitation, negligence) or otherwise, and to the extent permitted by applicable law, Two Two Eight Limited does not accept liability of any kind to any third party and disclaims all responsibility for the consequences of any third party acting or refraining to act in reliance on the Information.

We have not independently verified the accuracy of information provided to us and upon which we have relied. Accordingly, we express no opinion on the reliability, accuracy, or completeness of that information.

The statements and opinions expressed in the Report have been made in good faith, are based on information available as at the date of the Report and on the basis that the information is true and accurate in all material respects, and not misleading by reason of omission or otherwise.

We reserve the right, but will have no obligation, to review or amend the Report if any additional information, which was in existence on the date of this report was not brought to our attention, or subsequently comes to light.

We have relied on forecasts and assumptions about future events which, by their nature, are not able to be independently verified. Inevitably, some assumptions may not materialise and unanticipated events and circumstances are likely to occur. Therefore, actual results in the future will vary from the forecasts upon which we have relied. These variations may be material.

This report is issued pursuant to the terms and conditions set out in our contract with MPI and the Terms of Business attached thereto.