

The New Zealand Government

Accelerate the Aquaculture Strategy: investment roadmap



**Te Kāwanatanga o Aotearoa** New Zealand Government

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## Introduction

In 2019 the Government released its Aquaculture Strategy, which set a goal of a sustainable, productive, resilient and inclusive aquaculture sector worth \$3 billion in annual revenue. The Fit for a Better World roadmap seeks to accelerate the aquaculture strategy and achieve this goal by as soon as 2030. This Accelerate the Aquaculture Strategy: Investment Roadmap outlines the key infrastructure and research investments currently underway and those required to accelerate delivery of the Aquaculture Strategy to achieve this goal.

#### A growth pathway to \$3 billion

The investment roadmap follows a defined "growth pathway" to realising \$3 billion in revenue by as soon as 2030. Investment needs are grouped as follows, according to the growth pathway:

- Maximise the value of existing aquaculture: these investments will ensure unused water space is developed and fully utilised, and the most value possible is derived from existing aquaculture production
- **Open ocean salmon aquaculture:** these investments will enable salmon aquaculture to contribute almost half of the \$3 billion goal by enabling production of up to 70,000 tonnes of salmon per year from more exposed farming locations
- New opportunities including seaweeds and new species: new opportunities will position New Zealand's aquaculture industry for the longer term. While our immediate focus is on known opportunities, investments in new opportunities over this time will ensure the industry is resilient and adaptable to change, and New Zealand cements a unique position in the global aquaculture market.

A fourth category of investment needs will **underpin the sector's success**: these investments will provide benefits across the existing and future components of the aquaculture sector. These provide the foundations from which the growth pathways can build toward \$3 billion.

#### How the roadmap will be implemented

We will establish an investment governance group with government agency, Māori, industry and research organisation input to agree the annual priorities, identify funding options and identify who will own and lead delivery of key investment needs.

Different investments will need to be led by different parties. For example, infrastructure projects with public and private benefit may be led by the Government, infrastructure with purely private benefit should be led by the sector, and science will be led by research organisations and universities informed by industry priorities and funded through partnership with industry. The success of the Aquaculture Strategy depends on collaboration across these groups. The investment governance group will act to coordinate these activities, ensure collaboration, further prioritise investment and monitor progress of this roadmap.

The roadmap sits within the Government's broader aquaculture work programme set by the Aquaculture Strategy and annual strategy implementation plans. The roadmap should be read alongside the Aquaculture Strategy implementation plan to provide the full context of Government actions to achieve the Aquaculture Strategy's goals. Links to the Aquaculture Strategy's actions are noted throughout. The roadmap will be reported on in line with the Strategy.

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# **Opportunity 1:** maximise the value of existing aquaculture

Contribution to the \$3 billion goal \$3 b \$3 b \$1.5 b of the \$3 b goal Potential value from maximising the value of existing aquaculture space \$650 m 2020 sector value

#### If the investments and actions identified in this section are progressed then by 2030:

- The sector's spat requirements for current production and growth will be met by well developed nursery and hatchery infrastructure, and these will support research to ensure spat meets productive needs and is resilient to changes in the environment
- Port and wharf infrastructure will not be a constraint on aquaculture growth
- Consented but undeveloped farm space will have been developed and will be farmed to its productive potential
- Processing infrastructure will meet increased production volumes, including for high value products, and automation of processing
- Infrastructure and research systems will support development and commercialisation of new products, enabling diversification and building resilience across export markets

#### Current context: key investments and Strategy actions underway to support this outcome

	Investments
Infrastructure	Ōpōtiki harbour and mussel factory construction to support development of an inclusive aquaculture industry and create local jobs, unlocking over \$150 m in value once fully developed in Te Moana-a-Toi.
	Te Ariki Tahi/Sugarloaf wharf redevelopment to enable development of up to 2200 hectares of space and up to \$100 m in value in the Firth of Thames.
	Moana oyster farming transformation project to adopt flip-farm technology in Coromandel and Northland to revolutionise the oyster industry, lift productivity and create jobs. This is also supported by Moana's investment in increased hatchery capacity.
Research	Cawthron Institute – Shellfish Aquaculture Platform: supporting shellfish aquaculture through spat supply, improved genetics, precision farming methods and new products; enabling new and emerging species; and ensuring resilient production with improved shellfish health management, disease risk mitigation and biofouling management.
	Plant & Food – Cyber-Physical Seafood Systems: aiming for 100% utilisation and maximum value from wild caught and aquaculture seafood.
Other	The industry's spat strategy to guide research, innovation and productive focus on mussel spat supply over the next decade has informed investment needs identified in this section of the roadmap.



Actions completed under the Aquaculture Strategy	Strategy outcome/action number	Lead agency
Support the implementation of the National Environmental Standards for Marine Aquaculture to create confidence to invest and enable changes to trial new species and technologies. Implementation guidance was published in Q1 of 2021.	Productive - action P3	MPI
Support an industry-led spat strategy to safeguard from the impacts of climate change and provide for planned growth. The industry's Spat Strategy was finalised in July 2020. Agencies will work with the industry to progress the actions identified for government agencies.	Resilient - action R6	MPI
Actions underway under the Aquaculture Strategy	Strategy outcome/action number	Lead agency
Publish a research roadmap for accelerating delivery of the Aquaculture Strategy.	Productive - actions P1, P8	MPI
Support and facilitate an industry-led plan for hatchery infrastructure for oysters and mussels.	Productive - action P9	MPI
Input into development and assessment of applications for emerging infrastructure investments.	Productive - action P10	MPI
Actions to be commenced under the Aquaculture Strategy	Strategy outcome/action number	Lead agency
Identify how the government could de-risk the transition stage between research and commercialisation to accelerate development.	Productive - action P2	MPI

\* Strategy outcome/action number refers to the reference number used in the <u>Aquaculture Strategy: implementation plan</u>.

#### Key investments required to maximise the value of existing aquaculture

	What we need	Investment	Estimated cost
	Infrastructure		
Priority <sub>W1</sub>	Increase hatchery mussel spat production to increase retention, resilience and value and provide for 100,000 tonnes of adult mussels. This will support development of consented, undeveloped space. New hatcheries should be geographically spread around farming regions, with an immediate priority being in the North Island.	Three or more mussel hatcheries, depending on their size	\$20-40 m per hatchery
Priority M2	Develop farm space in Auckland, Waikato, Ōpōtiki, Tasman and Canterbury, which is consented but not developed, producing up to \$220 m in value by as soon as 2030.	Develop consented space	> \$100 m
Priority N3	Upgrade Port Tarakohe in the Tasman district to increase landing and servicing capacity for consented space (see investment M2).	Upgrade Port Tarakohe	\$20-30 m
Priority W4	Develop land or sea-based nurseries for on growing wild spat including from the Te Oneroa-a-Tōhe GLM9 fishery, for transfer to marine farms to increase spat survival, retention and productivity.	Land or sea-based spat nursery	\$1-10 m
M5	Increase processing capacity for mussels and oysters to accommodate growth in production, including new product formats.	Increase capacity of processing facilities and build new as required	\$10-20 m per factory
M6	Oyster hatcheries to grow more resilient and productive spat, to enable growth.	Two or more oyster hatcheries	\$5-15 m per hatchery
	Research		
Priority M2	Research to breed shellfish stock that survives and thrives in new and changing environmental conditions, in response to climate change, biosecurity threats and the emerging needs of open ocean farming. This will likely be conducted within the hatchery infrastructure from M1. This research will include successful breeding of triploid oysters to enable for year-round productivity.	Breeding programmes to ensure resilient and productive shellfish species	\$10-20 m
Priority 8M	Research to improve mussel spat retention to improve productivity and achieve the most efficient use of spat resources.	Research into spat retention	\$10m +
M9	High value product development from existing species, with clear pathways to commercialisation to increase the productivity of existing farm space. This could utilise methods such as drying and extraction to minimise transport emissions.	High value product development from existing species and commercialisation pathways	\$10m +

## **Spotlight on spat**



Green-lipped mussels are currently our most significant aquaculture species and will continue to be critical in a \$3 billion sector. Mussel spat is therefore a critical focus under the roadmap.

To maximise the value of the existing industry, expanding the supply of selectively bred hatchery spat is essential to ensure we have highly productive spat that meets market needs and is resilient to changing environmental conditions. For oysters, expanding the supply of selectively bred triploid hatchery spat is also necessary to achieve resistance to disease, enable year-round harvest, and deliver market premiums. Key context to future investments in spat rearing includes that:

- Spat supply is currently a key constraint on growth
- Issues with spat retention need to be understood and addressed
- Hatchery spat has been shown to be significantly more productive than wild spat.



#### **Objective:**

To improve health, survival and retention of spat caught from farms and harvested from Te Oneroa-a-Tōhe, to enable continued and increased productivity in the shortterm while hatchery capacity is developed. These learnings can also be applied to hatchery spat.

#### Investment:

M4 – Land based spat nursery for on growing wild spat



### Breeding to improve productivity and resilience

#### **Objective:**

Continue to develop breeding programmes capable of producing spat that is resilient to climate change and ocean acidification, while meeting market demands for product qualities.

#### Investment:

**M7** – Expand and continue breeding programmes to ensure availability of resilient and productive shellfish species for the whole industry



#### Develop hatchery capacity

#### **Objective:**

To meet demand for selectively bred spat as the industry grows, and enable a transition to hatchery spat as wild spat supplies become constrained.

#### Investments:

**M1** – Three or more mussel hatcheries to produce enough spat for 100,000 tonnes of mussel production

M6 – Two or more oyster hatcheries to enable growth

## **Opportunity 2: open ocean** salmon farming

If the investments and actions identified in this section are progressed then by 2030:

- The regulatory framework will support investment confidence, innovation, and sustainable growth to unlock
  open ocean salmon farming
- We will have an open ocean salmon industry producing 60-70,000 tonnes of high value salmon per year
- Research space will enable farming testing of farm structures and farming methods, which may be licensable to other countries
- Hatcheries and research facilities will enable and production of smolt for 60-70,000 tonnes of adult salmon



#### Current context: key investments and Strategy actions underway to support this growth opportunity

	Investments
Infrastructure	Four industry-led resource consent applications under the Resource Management Act 1991 to establish pioneering open ocean salmon farms – one in Marlborough, one in Otago and two in Southland.
	Plant & Food capital investment – flume tank to enable scaled testing of equipment for open ocean environments.
	Southland salmon hatchery to produce up to 6 million smolt at full development (enough for 25,000 T of harvest weight).
Research	Plant & Food Ngā Tai Hōhonu – Our Growing Futures™ Direction Open Ocean Aquaculture: examining species, performance and production systems for open ocean finfish aquaculture.
	Cawthron Institute: improving the efficiency and productivity of salmon through nutrition and breeding, to reduce production costs and minimise environmental footprint.
	Cawthron Institute – Ngā Punga o Te Moana: Anchoring our Open Ocean Aquaculture Future to deliver the knowledge and technology Aotearoa New Zealand needs to accelerate and scale-up its shellfish and seaweed open ocean aquaculture transformation.

Actions underway under the Aquaculture Strategy	Strategy outcome/action number	Lead agency
Spatial mapping – taking into account the range of uses and values in marine space, and environmental constraints to identify the most suitable opportunities for open ocean salmon farming.	Sustainable – action S1	MPI, DOC
Fit for purpose regulatory framework for open ocean aquaculture to support sustainable growth and enable innovation and testing of new farming technology and methods.	Productive – action P4	MPI

Open ocean salmon farming			
	What we need	Investment	Estimated cost
	Infrastructure		
<b>Priority</b>	Up to ten open ocean salmon farms and supporting infrastructure to produce 60-70,000 T of salmon and drive growth to \$1.5 billion in salmon revenue.	Up to ten salmon farms, including well boats and other service vessels	>\$1.3 b
Priority 05	Enough salmon smolt, optimised for open ocean farming, to support 60-70,000 T of open ocean salmon farming.	New or upgraded salmon hatcheries to produce smolt for 60-70,000 T by 2030	\$100 m
03	Processing factory capacity for high value salmon products generated by open ocean farming volume.	Salmon processing facilities	\$200 m
04	A domestic feed mill to supply feed suited to our species and environmental conditions and reduce reliance on imported feeds, while enabling use of New Zealand by-products. Viable at 30,000-60,000 T industry.	New Zealand based feed mill	\$70 m
05	A heavy engineering hub to enable development and maintenance of farm infrastructure, with potential to licence intellectual property to other countries.	Heavy engineering capability and infrastructure	> \$20 m
	Research		
Priority 90	Research to optimise production efficiency, robustness and resilience of salmon to environmental change and open ocean farming conditions.	Salmon performance research	> \$20 m
Priority 20	Testing and development of open ocean farming structures to ensure they are fit for purpose for our environments.	Research and development of open ocean farming infrastructure	> \$20 m
08	Open ocean farm monitoring systems and an online platform to make environmental monitoring information more accessible, to improve public knowledge and support social licence.	Research and development into open ocean monitoring approach and technology	\$1-10 m

## Spotlight on open ocean salmon

- Salmon is our highest value aquaculture food product per hectare.
- Reaching our target of \$1.5 billion from salmon would only take 60-70,000 tonnes of production, from up to 10 farms, occupying as little as 100 surface hectares of farm infrastructure in total, across Aotearoa.
- This requires investment to scale up production across the value chain, from research into breeding and farming methods, smolt production to farming to processing and marketing.
- Our vision for open ocean salmon farming, which can be realised through the investments set out in this roadmap is for an open ocean salmon farming sector that:
  - is environmentally sustainable, with farms in the right places that are sensitive to other uses and values and resilient to the impacts of climate change, and located appropriately for biosecurity management

- is highly productive, making the most efficient use of the space they occupy within environmental constraints
- enables an inclusive aquaculture workforce
- produces a product diversified from global salmon supply.
- A fit-for-purpose regulatory framework for open ocean aquaculture is also a critical component of a successful future open ocean salmon farming industry. This is a key action being progressed under the Aquaculture Strategy.



## **Opportunity 3: new opportunities**

New opportunities extend beyond our existing species and farming systems. While the core investment focus in the short to medium term is the known opportunities outlined earlier, investments in new opportunities will grow over time to position the sector to diversify in response to changes in the climate, markets and social demands. This will enable New Zealand to maintain and grow a unique position in the global aquaculture market. This section sets out an approach to investment in new opportunities rather than specific investments, which are not yet known. Our approach to these opportunities will be:

- Research funding will support prototyping and 'fast fail' testing of new opportunities, promote collaboration, sharing of knowledge, and will avoid duplication of effort
- Funding decisions will consider how new opportunities should be prioritised by considering their likelihood of success, strategic fit for Aotearoa and potential return on investment.

As a result of this approach and existing investments, outcomes by 2030 may include:

- A thriving seaweed sector providing a range of high value products and environmental services, and micro algae aquaculture will be established at a commercial scale
- A warm water finfish species and an additional shellfish species will have been developed for commercial farming
- Land based recirculating aquaculture systems will have been tested from hatchery to grow-out, with their commercial viability and role in the New Zealand system understood
- Support for opportunities for iwi and hapū to develop their aquaculture aspirations.

#### Current context: key investments underway to support this growth opportunity

# InvestmentsResearchPlant & Food – Reimagining Aquaculture: research into autonomous mobile aquaculture systems for high value finfish production.Cawthron Institute – National Algal Research Centre: targeted research into algae species for use in high value products, including for example application in pain medication.NIWA – kingfish recirculating aquaculture system: proof of concept for a land based kingfish farming industry.Seaweeds: the Government currently has \$26 m invested in a variety of seaweed aquaculture initiatives to develop farming and processing techniques for food, nutraceutical, animal feed, environmental restoration and pharmaceutical functions. Work is also ongoing to consider regulatory settings to enable growth of a thriving seaweed sector.Plant & Food – Accelerated breeding for enhanced seafood production: breeding programmes for alternative finfish farming species including tāmure / snapper and arara / trevally, using advances in genomic technology to assess and select desirable traits faster and with less cost than traditional breeding.Cawthron Institute – Ngā Punga o Te Moana: Anchoring our Open Ocean Aquaculture Future to deliver the knowledge and technology Aotearoa New Zealand needs to accelerate and scale-up its shellfish and seaweed open ocean aquaculture transformation.

#### Contribution to the \$3 billion goal



## New opportunity spotlight: seaweeds

Seaweed culture will focus on development of new high value aquaculture products. Seaweeds have a variety of potential applications, and many of these align strongly with the Aquaculture Strategy's 'Sustainable' and 'Productive' outcomes.

We are partnering with the sector and taking a coordinated approach to investing in opportunities, and addressing regulatory constraints, to ensure the successful development of a thriving seaweed industry.

Realising this opportunity requires investment across the value chain, from hatchery to market. This approach includes development of a collaborative seaweed group and formulation of a seaweed strategy to facilitate partnering across the sector.

Potential 'sustainable' functions of seaweed being investigated:

- Bioremediation potential to uptake of carbon dioxide and nutrients
- Biodiversity and habitat provisioning
- Coastal regeneration
- Coastal protection and buffering from wave energy
- Seaweed hatcheries and nurseries.

Potential 'productive' uses of seaweed being investigated:

- Animal feed, fertilisers, bio-stimulants, nutrition
- Indigenous plant-based food production
- Agriculture methane reduction
- Pharmaceuticals and nutraceuticals
- Plastic and textile alternatives, and biofuels
- Blue carbon sequestration.

#### Case study: Developing a seaweed sector framework for Aotearoa New Zealand

Global seaweed production has more than doubled in the last 20 years, exceeding natural supply – now more than 30% of global aquaculture production volume is seaweed.

Successful seaweed sectors overseas have hatcheries, large and small-scale farming operations, processing capability and established seaweed-based products. These are assisted by on-going research and development, and workforce support.

Here in Aotearoa New Zealand, we have a fledgling but highly dynamic seaweed sector operating at small scales, but many gaps and barriers exist, limiting its potential growth.

The right framework grounded in ecosystem-based management principles could enable a thriving seaweed sector for Aotearoa New Zealand.

To achieve this, the Sustainable Seas National Science Challenge is working with iwi, stakeholders, industry, researchers, and government agencies to co-develop a Seaweed Sector Framework grounded in blue economy and ecosystem-based management principles. To date, reports have been published on:

- Market and Regulatory Focus
- Species Characteristics and Te Tiriti o Waitangi Considerations
- Environmental Effects of Seaweed Wild Harvest and Aquaculture Text credit: Sustainable Seas – Ko ngā moana whakauka

## **Opportunity 4:** underpinning the sector's success

If the investments and actions identified in this section are progressed then by 2030:

- Regulatory frameworks will support innovation and provide investment confidence across the aquaculture sector
- The biosecurity system will safeguard against pests and diseases, with tools in place to respond when threats arise
- The sector will be world leading in minimising its environmental impact including waste and emissions
- Education and training pathways will support growth to a workforce of 6,000+
- The impacts of climate change will be understood and responses and adaptation plans will be in place
- Diverse markets will be well established for added production volumes and intellectual property for indigenous products will be protected
- Remote farm management will support better farm design, more efficient management and lower
  emissions

#### Contribution to the \$3 billion goal



These investments and actions build the foundations for other growth opportunities to be realised, and ensure a resilient and sustainable industry. They are critical to delivery of the growth pathway.

#### Current context: key investments and Strategy actions underway to support this outcome

	Investments
Research	Cawthron Institute Strategic Science Investment Fund: Aquaculture Animal Health Strategies supporting the resilience of the aquaculture sector and enabling more informed and proactive farm health management.
	Moana Project – research to improve understanding of coastal ocean circulation, connectivity and marine heatwaves to provide information to support New Zealand's seafood industry.
Other	A report on plastic waste in aquaculture recommended keys actions to tackle plastic waste. Subsequent research in Marlborough has identified the volume of plastic generated from farming activities. Initiatives underway to recycle and minimise plastic use include a mussel float recycling programme and mussel float attachment projects.
	Aquaculture New Zealand signed the Government Industry Agreement with MPI to improve biosecurity readiness and response in their sector in September 2019. Signatories share the decision-making, responsibilities and costs of preparing for and responding to biosecurity incursions. By working in partnership, industry and government can achieve better biosecurity outcomes.

Actions completed under the Aquaculture Strategy	Strategy outcome / action number	Lead agency
Complete life cycle assessments for mussels and oysters to contribute to establishing a baseline for reducing waste and emissions. The assessments for mussels and oysters were published in Q4 2021.	Sustainable – action S7	MPI
Actions underway under the Aquaculture Strategy	Strategy outcome / action number	Lead agency
Modelling pest and pathogen spread to test an approach to determining the appropriate size of buffers between operational farming zones, and between-farm spacing within these zones (for all aquaculture). This will reduce biosecurity risk, notably the spread of pests and pathogens within and between operational zones.	Sustainable – action S1	MPI
Consideration of how aquaculture planning, innovation and investment confidence can be supported through the resource management system review.	Productive – action P6	MPI
Development of a comprehensive biosecurity approach for aquaculture.	Resilient – action R2	MPI
Preparation of an updated New Space Plan for delivering aquaculture settlement in a way that enables Māori to be early investors and meaningfully participate in new aquaculture opportunities.	Inclusive – action I4	MPI
Conduct life cycle assessments for salmon and develop a waste and emissions transition plan for the sector.	Sustainable – action S7	MPI & MfE
Actions to be commenced under the Aquaculture Strategy	Strategy outcome / action number	Lead agency
Market development for additional product volumes arising from the planned growth toward \$3 billion to maintain high value market positions and identify new opportunities.	Productive	NZTE
Regulatory verification to support claims of active ingredients such as nutraceuticals to build consumer trust and confidence.	Productive	MPI
Build public understanding and social licence for aquaculture through education.	Inclusive – action I1	MPI
Build understanding of the size of the workforce and range of skills required in a \$3 billion aquaculture sector likely to employ 6,000+ people, to enable investment in career pathways and education and training programmes.	Inclusive – action I3	MPI
Develop and protect the provenance of indigenous and mātauranga Māori products, and retain benefits to Māori and Aotearoa, in line with Te Pae Tawhiti (Wai 262).	Inclusive – action 18	TPK, MPI

Investment requirements: underpinning the sector's success			
	What we need	Investment	Estimated cost
	Infrastructure		
U1	A waste and plastics minimisation programme to expand recycling, research alternative technologies, and undertake research and trials of recycling options for plastic ropes and nets, and reduce other waste from the sector. This could be a shared initiative with other sectors.	Waste and plastic minimisation and recycling programme and associated infrastructure	\$10-20 m
U2	Laboratory capacity for surveillance and response testing to support industry growth.	Increased laboratory capacity	> \$20 m
	Research		
Priority <sub>CO</sub>	User friendly surveillance tools to enable proactive response to contain and mitigate biosecurity threats before spread occurs, and limit the impact on productivity. These tools will identify pests and diseases and enable pathway management plans to minimise the risk of introduction and spread of pests and diseases.	Biosecurity surveillance tools and pathway management plans	\$10-20 m
Priority 04	Targeted investment into Māori led and mātauranga Māori informed research to give effect to Māori aspirations. This could include research into alternative species, farming methods, environmental management approaches and reinvigorating traditional practices. To be led by Māori, for Māori.	Targeted investment in Māori led research	\$10-20 m
D1011	Models and maps to characterise the open ocean environment at a range of spatial and temporal scales, including capturing extreme weather patterns. This will help design farm structures, identify suitable sites for farms, and improve regulation, policy, and safety.	Marine environment forecast maps, data and models to inform spatial mapping for growth	> \$20 m
U6	Research and trials to explore transportation formats such as live, chilled and frozen, for high value products to minimise carbon impacts by reducing reliance on air freight.	Research into alternative product transportation formats	\$1-10 m
U7	Research and development to further automate processing of mussels, oysters and salmon to improve productivity and alleviate workforce challenges.	Research and development into automation of processing	\$1-10 m
U8	Research to develop technology to remotely monitor farms, providing data on structures, crops, water and environmental conditions, and a pathway to commercialisation. This will enable greater efficiency and lower emissions, improved safety and response to environmental changes, and produce licensable technology for export.	Smart farming research programme and "ocean tech" innovation pathway	\$1-10 m

## Spotlight on mātauranga Māori

The Aquaculture Strategy aims to ensure an inclusive aquaculture industry, where Māori values and aspirations across the work programme are foundational.

Wai 262 and the all-of-Government response also guides our thinking for the roadmap – in particular ensuring we provide for kaitiaki to exercise mātauranga over their taonga species.

Mātauranga Māori is the knowledge, cultural values and world view according to Māori. It is a holistic concept and a complex system of experiential knowledge that comprises intergenerational beliefs, values and practices that contribute to the sustainable management of the marine environment. The ethic and practice of kaitiakitanga (spiritual and physical guardianship) is one expression of mātauranga Māori.

The interface between western science and mātauranga Māori is complex, but ensuring that Māori are positioned to articulate their own research needs is fundamental. To support this, the roadmap identifies research into Māori aquaculture, by Māori for Māori, as a priority.

Some examples of mātauranga Māori aquaculture research include:

- Taking a Te Ao Māori approach to developing business cases for potential aquaculture opportunities including a diversity of species
- Developing research into improving the health and commercial opportunities for taonga species (e.g. Toheroa)



- Protecting intellectual property rights for taonga species that are subject to bioprospecting
- Identifying alignment between western science and mātauranga Māori e.g. ecosystem based management
- Utilising and reinvigorating the use of traditional natural materials and aquaculture practices.

#### A multidimensional approach to measuring success

Through a Te Ao Māori lens, defining success is multi-dimensional. The figure below is derived from a Government funded, iwi-led aquaculture research programme 'exploring aquaculture opportunities for Ngā lwi I te Rohe o Te Waiariki'. Incorporating Māori values for measuring and driving success across the aquaculture sector is critical, and will help identify investment needs.

#### Case study: Te Kete Rau Kotahi

The Government's Vision Mātauranga Capability Fund is supporting Māori researchers from the Cawthron Institute to support a collective Kaupapa Māori Aquaculture research project. The project, called "Te Kete Rau Kotahi" aims to develop a mātauranga centred, ecosystem-based aquaculture strategy for Bay of Plenty, working closely with members of Ngā iwi I Te Rohe o Te Waiariki collective.

Project leader, Te Rerekohu Tuterangiwhiu says "Mātauranga Māori associated with aquaculture is a rich source of knowledge that has been underutilised in the aquaculture industry – we want to better understand the extent of the connection between the two and the potential it represents for Māori." The project runs for two years.

Text credit: Cawthron Institute

## **Spotlight on climate change response**

Climate change poses a number of challenges to the aquaculture sector, through both impacts on farming, and the need to reduce waste and emissions as we move toward a zero-emissions economy.

Our response to climate change includes a number of actions through the Aquaculture Strategy, and a number of proposed research investments set out in this roadmap:

#### Responding to and adapting to change

- Forecasting the effects of climate change on the aquatic environment; planning and supporting actions for resilience and adaption (Aquaculture Strategy action R4 and investment roadmap item U5)
- Research and development of polyculture and ecosystem enhancement (investment roadmap: new opportunities)
- Breeding programmes to ensure resilient and productive and productive shellfish species (investment roadmap item M7)
- Salmon performance research (investment roadmap item O6).

Reducing waste and emissions across the sector

- Life cycle assessments to understand baseline emissions (Strategy action S7)
- Waste and plastic minimisation and recycling (investment roadmap item U1)
- Research into alternative product transportation formats (investment roadmap item U6)
- Smart farming research programme and "ocean tech" innovation pathway to reduce farm visits (investment roadmap item U8)
- High value product development and commercialisation pathways (investment roadmap item M9)
- Potential seaweed farming to capture carbon (investment roadmap: new opportunities).

Enabling response, adaptation and lower emissions across the sector:





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