National Science Challenges | SCIENCE FOR TECHNOLOGICAL INNOVATION | Kia kotahi mai – Te Ao Pūtaiao me Te Ao Hangarau

FAQS: Precision Farming Technology for Aquaculture project:

October 2017.

How much is the project funded for and for how long?

The SfTI Board has approved funding of $2m ex-GST between 1 July 2017 and 30 June 2019.

Specifically, what value would the technology bring to New Zealand's economy?

SfTI is the 'technology for' National Science Challenge that seeks to boost New Zealand's prosperity using the physical sciences and engineering.

Advances in precision farming technologies that address costs and risks of ocean farming are required to realise New Zealand's full potential for high value aquaculture production.
This project aims to develop innovative technologies that are essential to enhance New Zealand's global position in high value aquaculture products.

The export of technology developed in this arena is a key driver.

What is the main aim of the research?

To develop technology that can be exported sold domestically and internationally.

What practical applications will the technology seek to produce?

The project seeks to produce technology that can be used and sold locally and sold and exported overseas by:

- enabling future development and implementation of precision farming technologies for coastal and offshore aquaculture farms supporting increased sustainable production and value within existing coastal space, while unlocking the potential of new offshore farms here and overseas
- paving the way to automated aquaculture precision farming locally and internationally
- providing domestic farmers with the ability to remotely make decisions around managing their farm and stocks, which currently lie 'out of sight'.

Why is this research project needed?

Project innovations that arm farmers with remote intelligence on the status of their farms and the condition of their stock and growing waters, would remove uncertainty, enabling farmers to make informed decisions about their offshore farms from their desk.

How will this project achieve its aims?

By:

- developing new chemical and imaging sensors
- achieving breakthroughs in underwater communications and machine learning.

What difficulties currently exist in this area?

In contrast to farming on land where automation of farm information is rapidly becoming the norm, aquaculture farmers around the world currently face several difficulties regarding information automation.

For example, farms must be physically accessed by boat, stock health and condition manually recorded, and onsite operators needed for remotely operated vehicles. State-of-the art sensing devices are currently expensive, while delicate laboratory equipment remains inconceivable on a marine farm. Technology developed by this project will seek to overcome these constraints local and overseas application.

What current and future issues do these difficulties cause to farming efficiency?

Often critical information arrives late, or not at all. As farms move offshore, the costs of a manual approach will escalate. This leads to inefficient deployment of resources and little knowledge from which to base decisions around harvesting and managing risks to farms.

What immediate developments does the programme seek to achieve?

- the development of chemical sensors that can sense the amount of food and nutrients in the water, using laser spectroscopy and fibre lasers

  farmers enabled to "see" their farm and stock condition in real time from a computer or mobile device through imaging sensors using artificial intelligence
- achievement of short range (<100m), efficient, and cost-effective underwater communications, overcoming severe seawater attenuation, and unlocking the future potential of untethered sensors and robotics
- Integration of communications and sensors technologies through a novel on-farm communications hub.

What benefits could New Zealand see from the project?

The development of new technologies that can be used and sold domestically and exported overseas would boost our prosperity, influencing:

- New Zealand's role at the forefront of precision aquaculture farming
- the future development and implementation of precision farming technologies for coastal and offshore aquaculture farms
- optimised production and value of existing coastal space
- accelerated expansion of future offshore farms
- ability for farmers to remotely "see" the status of their farms and stock, meaning reduced need for site visits (which can cost $3-6k/visit)
- ability for the industry to manage farms on local to national scales in response to monthly, seasonal, and annual cycles in stock condition, bringing consistent production of premium value products Locally, in 5-7 subsequent years, precision farming technologies could bring the industry an estimated 50% pa (>$200M pa) gain for the Greenshell™ mussel industry alone.

Broader benefits are likely to accrue through:

- technology application beyond aquaculture, eg ports and harbours having real-time surveillance to manage dredging activities, shipping, and biosecurity threats
- mass underwater surveillance of ship hulls (required in New Zealand by MPI from 2018)
- use of technologies within emerging coastal ocean observing programmes for monitoring the state of the environment
- broader applications of laser spectroscopy in environmental and atmospheric science, and in industrial technology.

Which research partners are involved in the project?

Researchers from Nelson-based Cawthron Institute, Auckland, Victoria and Canterbury Universities, and Eco Research Associates. NZ Product Accelerator is also part of the project.

What skills do the research partners bring to the project?

The programme creates a new, multi-disciplinary science team for New Zealand. The team combines cutting-edge research in sensing technologies, lasers, machine learning, and underwater communications with practical, applied research to provide disruptive practical solutions to the aquaculture industry. Aquaculture industry and an Industry Advisory Group will also participate.

Will industry players have a role?

The programme links with Information Technologies, and Boxfish Research. Knowledge exchanges with established international partners at the forefront of physical sciences and ocean engineering, eg Monterey Bay Aquarium Research Institute, will also take part.

As well, an annual workshop will be held in Nelson with the wider project team and industry to promote a hub of technological innovation around the aquaculture sector.

Who will lead the project?

Cawthron Institute Coastal and Freshwater Group Manager Chris Cornelisen will be responsible for project delivery and overall coordination. This will include cross-project collaboration with the Sustainable Seas National Science Challenge and other research programmes.

How will the research be implemented?

By a collaborative team including three research aim leads: Professor David Williams (UoA), Associate Professor Richard Green (UoC), and Dr Ross Vennell (Cawthron). Vision Mātauranga advisor, Shaun Ogilvie, and the Industry Advisory Group will be included.

How does the planned research and outcomes align with the Science for Technological Innovation (SfTI) National Science Challenge mission?

It has strong alignment with SfTI's *Robotics, Automation and Sensing* and *IT, Data Analytics and Modelling* themes. The research will contribute to SfTI's mission *to enhance New Zealand's capacity to use physical sciences and engineering for economic growth* through technological innovation and enabling a 'smart and connected' aquaculture industry.

Through active participation of Māori-owned companies, the research also contributes to Sfti's *Vision Mātauranga* theme.