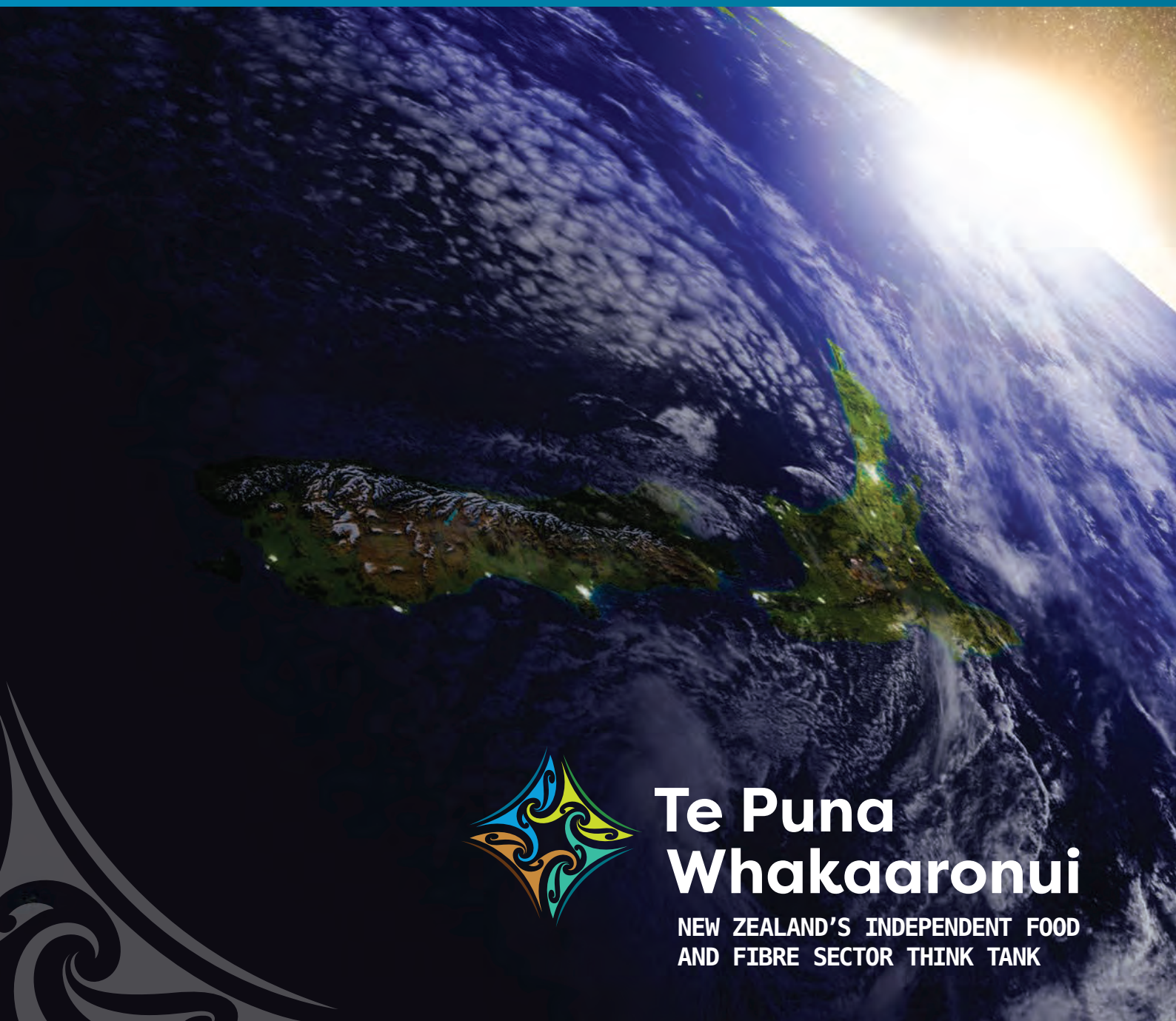
Harvesting value from satellite data

DECEMBER 2023



Te Puna Whakaaronui

NEW ZEALAND'S INDEPENDENT FOOD AND FIBRE SECTOR THINK TANK

About Te Puna Whakaaronui

Te Puna Whakaaronui, New Zealand's food and fibre sector think tank is working to drive transformation and fulfil the Primary Sector Council's recommendation for pan-sector thought leadership.

Te Puna Whakaaronui's role is to help lead, co-ordinate and implement change by providing thought leadership, strategic insights and advice to government, the food and fibre sector and stakeholders.

Te Puna Whakaaronui reports to, and is supported by, a Governance Group comprised of:

- Sir Brian Roche KNZM (Chair);
- Lain Jager, Chair of Te Puna Whakaaronui Thought Leaders Group;
- Caralee McLiesh, Chief Executive and Secretary to the Treasury;
- Ray Smith, Director General Ministry for Primary Industries; and
- Peter Chrisp, Chief Executive New Zealand Trade and Enterprise.

In addition, an independent Thought Leaders Group brings international, industry and business expertise and insights to the work programme.

Te Puna Whakaaronui has a voice independent of the Ministry for Primary Industries, its view does not represent government policy. The views and analyses in this report are those of Te Puna Whakaaronui.

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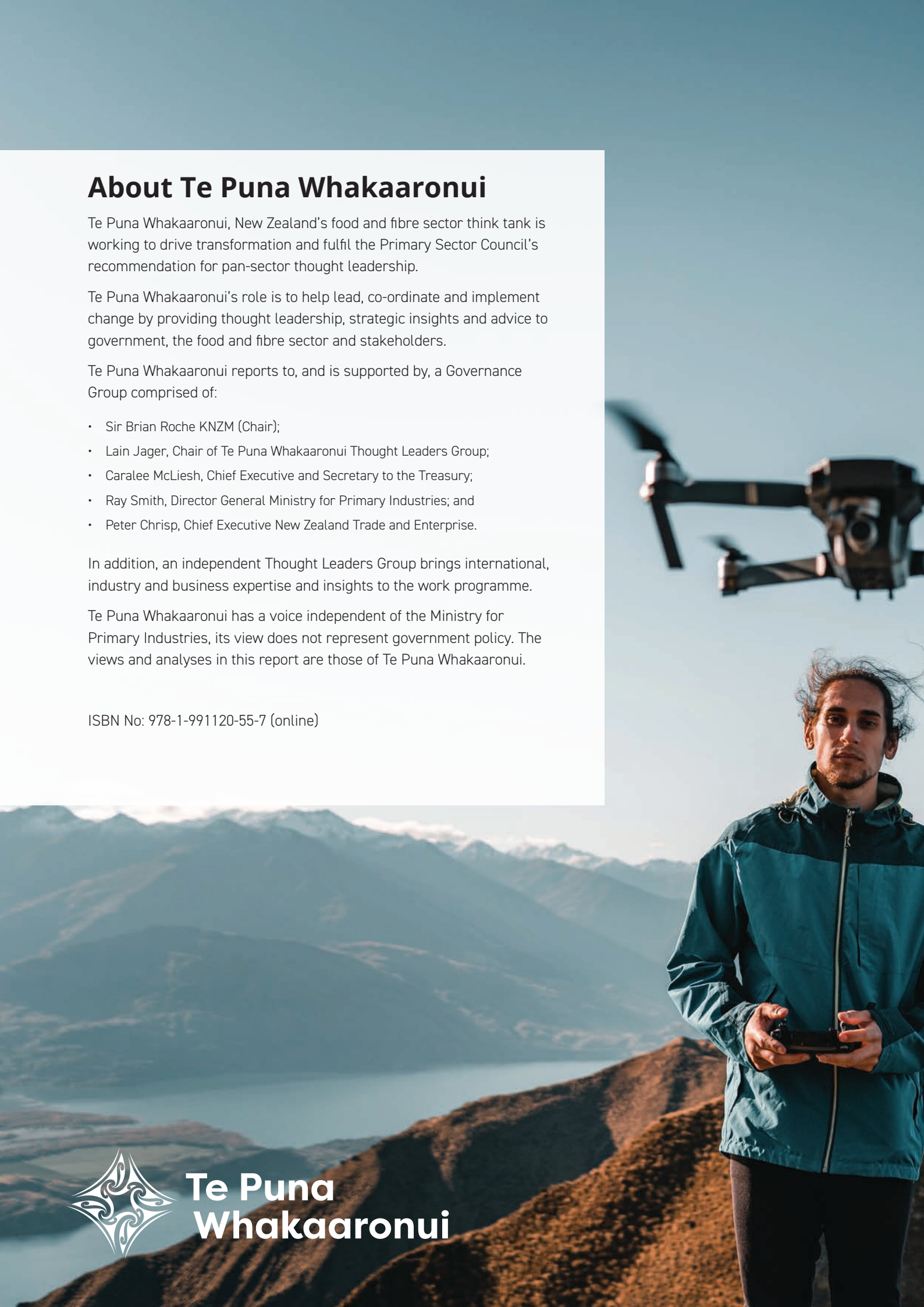

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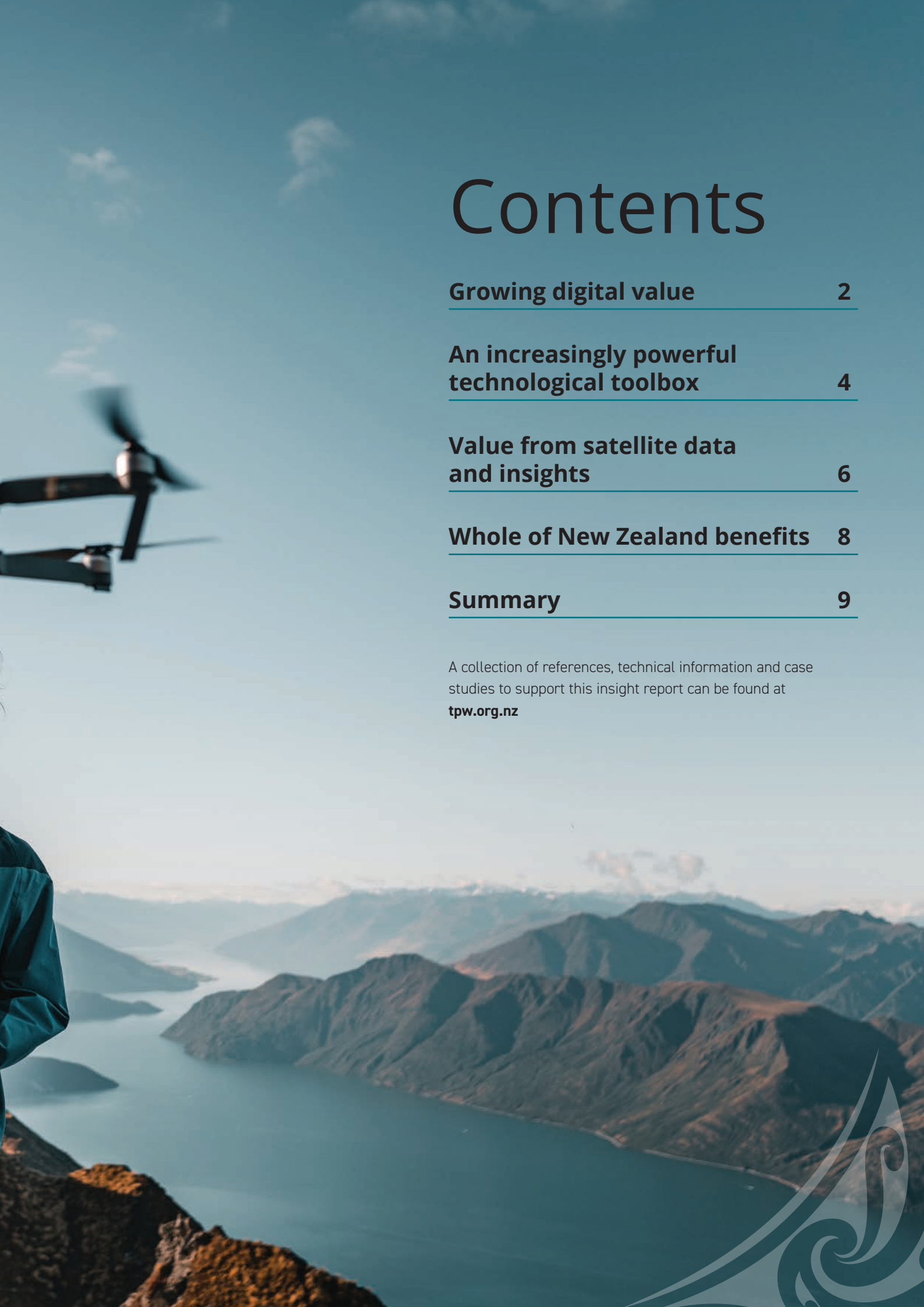

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A collection of references, technical information and case studies to support this insight report can be found at **tpw.org.nz**

Growing digital value

The global food system is changing rapidly, driven by climate change impacts, consumer demands, evolving technologies and geopolitical shifts.

The recent convergence of Artificial Intelligence (AI), remote sensing and satellite technologies, cloud computing power and scalable storage is transforming the collection and use of satellite data across industries.

Land and marine-based systems can now benefit from the rapid increase in the collection, automated analysis and application of data-to-information. Digital technology developments offers multiple exciting benefits to New Zealand, including:

- a new opportunity for carbon credit accounting at an individual tree level;
- a verified information source for native vegetation biodiversity credits;
- improved decision support and monitoring tools;
- a reduced need for physical property inspections, resulting in reduced compliance costs and inspection burden for farmers as well as regional councils and regulators;
- increased value capture from consumers through enhanced product verification.

These benefits are much-needed good news for New Zealand's food producing businesses, as well as a boost to work addressing the causes and impacts of climate change. The creation of incentives that appropriately reward land-owners for environmental improvements, as well as the capacity to provide verifiable evidence of these investments to interested parties, is the most significant outcome of advanced data collection and use. Wider benefits could include:

- increased carbon credit returns, and livestock benefits, from additional tree planting within food production systems;
- improved environmental monitoring of remote and coastal regions;
- early identification of land and marine vegetation damage from pests or weeds;
- environmental restoration monitoring; and
- comprehensive, nationwide data for civil defence, infrastructure planning and research.

Recent developments in satellite capabilities, coupled with enhanced digital technology, offer New Zealand a rare opportunity to target investment that will enable business, environmental, climate change, community and cultural benefits. The last time such an investment occurred in New Zealand was the roll out of ultra-fast broadband. At that time, the Minister for Communications, the Honourable Amy Adams, said: "better connectivity is critical to building a stronger economy and creating more jobs and higher wages". The Government made several investments to accelerate the use of this new technology. Today government investment in satellite data can accelerate and realise significant, community-wide benefits.

A non-competitive foundation for companies to innovate and promote new capabilities from has significant and tangible economic, productivity and environmental benefits. These might be the development and use of advanced AI within New Zealand's economy, improved productivity and value capture from the food system, or retaining and maintaining New Zealand's domestic interest in national data.

This insights paper, *Harvesting value from satellite data*, discusses how observational and remote sensing data can solve some of New Zealand's food and fibre sector issues. It outlines the opportunity to:

- procure satellite data centrally, for government, not-for-profit and targeted commercial use;
- invest in workforce skills through the education system;
- invest in the co-ordination of data/information within core agencies; and
- work to ensure national and international climate change regulations/standards are updated to allow the full benefit of new technologies to be realised.

An increasingly powerful technological toolbox

Digital technologies have supported food and fibre sector efficiency gains for decades in New Zealand.

Tractors guided by GPS have saved time and inputs, electronic devices have enabled vineyard and orchard crop optimisation since the 1990's. In recent years, smart farming has become both accessible and affordable as internet coverage has increased and technology has advanced.

Smart farming, or software managed farming, is:

- optimising plant and animal growth;
- enabling remote management of stock and pasture;
- enabling efficient use of water, power, fuel and fertiliser;
- monitoring territory for pests;
- predicting weather impacts; and,
- supporting long-term forecasting and financial analytics.

With increasing interoperability of remote sensors and smart devices farmers, growers and harvesters are further automating farm management and taking advantage of data from the farm to beyond the farm gate.

Satellite data can enable existing technologies to make a step change in production and environmental management. With increasing flyover frequency and resolution definition, satellites have become powerful data capture enablers. They now carry equipment able to produce large-scale and detailed imaging with the ability to demonstrate macro and micro geographic changes on the Earth's surface. Environmental monitoring software applications are advancing. Geographic information system (GIS) and machine learning software tools are invaluable for recording location-based data for the food and fibre sector, land and marine resource managers and some government agencies.

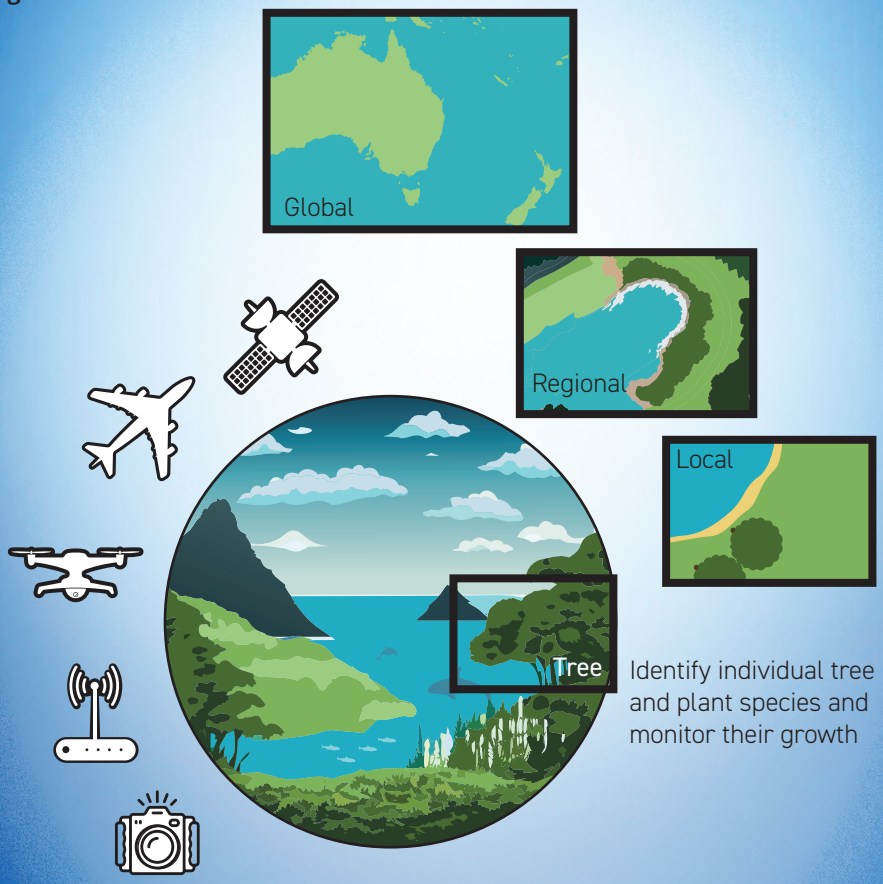
Satellite data capture and analysis is starting to be used on a situational basis by government agencies, for example, to inform the Cyclone Gabrielle impact assessment.

In addition, it is being used by commercial and not-for-profit organisations in New Zealand and internationally for food and fibre sector applications: mapping land-use change, monitoring oceans, supporting policy development and studying the impacts of climate change.

Applying AI to merging data sources, interpreting and creating new insights as well as monitoring capabilities, will power-up the sector. AI is already making real-time analytics possible, and scalable, to an extent unimaginable just a few years ago. In countries already embracing satellite data use alongside other data sources, research, IT and analytics companies are creating innovative software services.

Automated natural asset inventory

Technological advances have enabled the automated assessment of natural resources on individual properties and at a regional, national and global scale.



Identify individual tree and plant species and monitor their growth

Identify and monitor ecosystems on land and in coastal marine areas.

Common Sensors

Optical satellite sensors capture earth observations using visible, near infrared, and shortwave infrared wavelengths. Optical imaging is used in land cover mapping, vegetation monitoring, and urban planning. Optical sensors can provide medium (10m-30m) to high (<1m-5m) and very high (<30cm) resolution images and capture images kilometres to hundreds of kilometres wide.

There is a balance between resolution and coverage – some satellites capture low-resolution observations at large scale, other satellites capture high-resolution images, but at a much smaller scale.

Multispectral or hyperspectral sensors detect specific bands within the electromagnetic spectrum (over 400 bands at 30m resolution). The data provides for the analysis of the chemical and physical properties of the Earth's surface and shallow coastal areas. This can be used to map invasive species or mineral deposits.

Synthetic aperture radar (SAR) satellites can create high-resolution images by bouncing radar signals onto the Earth's surface and measuring the changes in the returning signal. SAR systems can obtain data during day and night and regardless of weather conditions or cloud cover. This data can support maritime, forestry, agriculture, land-use and civil defence applications.

Light Detection and Ranging (LiDAR) scanner data provides fine-scale 3D information and precise elevation information for detailed digital terrain models. To some extent LiDAR can penetrate through vegetation and the water column to reveal the underlying terrain structures. LiDAR scanners are used from the ground, on drones and on aircraft for high resolution mapping and surveying on local and regional scale.

Value from satellite data and insights

Making decisions based on current, comprehensive, quality information enables better outcomes in any business context.

Taking a food producer's perspective, all technologies that reduce time spent on repetitive reporting through automation is a clear time – and frustration – saver. The food and fibre sector, regional councils and government agencies that work with them, can harvest time and cost savings from standardised satellite data and analytics powered by verified algorithms. For example:

- many assurance inspections or audits can be automated;
- emissions can be benchmarked;
- sequestration can be assessed frequently at little cost;
- environmental actions, such as riparian planting, fencing or erosion control, can be verified at little cost;
- markets can be better informed, providing consumers with transparent information, in turn building confidence and value in New Zealand's food and fibre products.

The ability to work with near real-time information and to access detailed, high resolution information, offers a platform for innovation – potentially new services for farmers, growers, fishers and aquaculturists – and the prospect of new business opportunities.

Regulations must keep pace

Data curation and technological advances have enabled a level of detailed measurement capability not available when the Kyoto Protocol Emissions Trading Scheme principles were formed in 1997. Adjusting existing regulations could realise climate, environmental and financial gains through the inclusion of the true carbon capture capacity of farming platforms. Adding the value of riparian planting or individual trees to carbon credit calculations will add real-cash value to landowners.

Satellite data is already enabling individual tree tracking, crop biomass and yield predictions; work has been undertaken internationally to calculate the carbon sequestration of different tree species at different growth stages, as well as in soil. With further scientific understanding New Zealand could benefit from the sequestration value of retired production blocks, native forests, conservation land, regional reserves, riversides or waterway setbacks.

CASE STUDY: CarbonStack

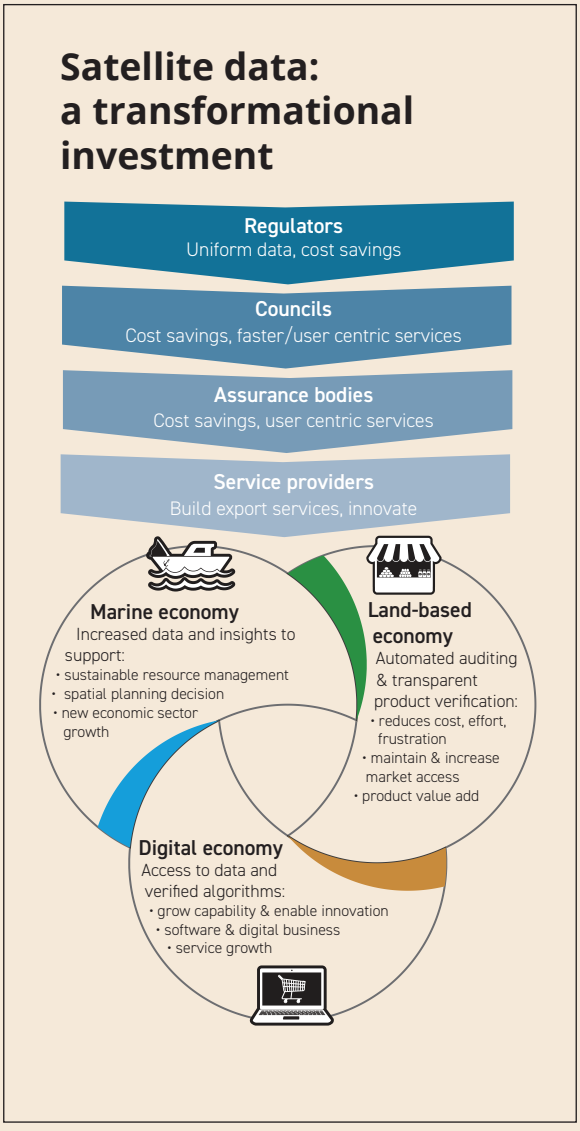
CarbonStack uses high resolution satellite imagery to monitor individual trees. Their software model simulates future climate scenarios and identifies the optimal mix of tree and plant species for resilience and CO_2 capture at each planting site.

The company previously used drones and aeroplanes to gather data – satellite offered a cheaper option with a wider capture area and detailed image resolution. CarbonStack now works with satellite imagery collection company, UP42, to gather high resolution satellite imagery of two million square kilometres per day. The images are provided at a 30cm resolution allowing CarbonStack to clearly identify individual trees, impossible at lower resolutions.

A machine learning algorithm is applied to the data to categorise trees by species, growth stage and calculate carbon offsetting capabilities. The data is added to CarbonStack's publicly accessible blockchain ledger, delivering transparency to the carbon off-setting market.

Whole of New Zealand benefits

Enabling easy access to satellite data streams and homegrown, verified, algorithms will unlock valuable economic opportunities.



Buying satellite data once and making it available to all central, regional and local government agencies, state owned enterprises and research agencies, as well as education and commerce has obvious financial cost efficiencies. From a food and fibre sector perspective, using a common dataset ensures the integrity of future verification systems. Efficiency, shared standards and data access provide the foundation for accelerated business innovation.

Future opportunities

Globally, both government and regional authorities already use satellite data to support and deliver core public services more efficiently for:

- emergency and disaster services resilience, planning and response;
- consenting, compliance and resource monitoring;
- biosecurity and pest management;
- biodiversity monitoring;
- future scenario planning and policy development; and,
- compliance and reporting on international agreements.

While work is needed to align existing data and processes, the system efficiencies, labour and resource savings from using a single data source will provide clear productivity gains for New Zealand. For example:

- access to satellite data can enable existing businesses and start-ups to build services for farmers, producers, processors and regultory bodies at pace,
- artificial intelligence can enable the amalgamation of existing content from multiple sources and integrate it into business and farm management systems; and,
- combining data with content from neighbouring farms, or similar food and fibre production operations, could produce strong regional and national insights that can return time savings or cash value. Sharing data could also support biosecurity and pest management programmes, or farmers during adverse events.

New industry development

Investment in satellite data and workforce capability will unlock new industries and revenue streams. Satellite data can:

- help identify optimum locations for new land and marine based activities;
- inform spatial planning; and,
- help build an information base for future voluntary biodiversity credit or incentive schemes.

Summary

Benefits of using satellite and remote sensing data

Verifying environmental claims is fundamental for New Zealand's food and fibre sector to:

- maintain or gain market access
- access finance & investments
- maintain social license
- maintain consumer confidence
- unlock revenue opportunities from carbon & biodiversity credits

Public sector can gain efficiencies in:

- disaster resilience, planning & response
- consenting, compliance & resource monitoring
- biosecurity & pest management
- biodiversity monitoring
- scenario planning & policy development
- reporting on international agreements

New Zealand has an opportunity to leverage its deep expertise in agricultural sciences, ecology and biosecurity to gain real value from integrating remote sensing and AI powered data-decision tools.

The development and application of verified algorithms can automate compliance and assurance reporting create cost-savings, verify products' environmental claims and unlock new investment.

Investment in data capability and infrastructure, as well as support for science will produce quick wins – as well as progress long-term climate goals. Food and fibre producers will have more tools to enable faster uptake of low emission practices. The ability to make transparent and verifiable product claims will engender customer and trading partner trust, maintain – and potentially increasing – trade and export levels.

Government, business and regional authority leadership is key to unlocking data-driven economic and environmental benefits for New Zealand; government provision of pre-competitive capabilities to accelerate commercial innovation of services is a proven model. Rarely does an opportunity come along that can enable so many benefits to so many stakeholders. The opportunity to harvest value from digital data is one New Zealand must take.

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