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CarbonCrop

Scaling New Zealand Forest Restoration with Carbon Credits and Artificial Intelligence

International Tropical Timber Organisation, Yokohama, November 2022

NZ NDC goals under Paris - Forest is a major contributor to goals, this enables markets.

NZ ETS creates incentives to drive progress towards NDCs through increased forest carbon sequestration.

Market friction can limit the effectiveness of incentive frameworks.

Integrated solutions using artificial intelligence, remote sensing, and automation can reduce friction, maximise effectiveness.

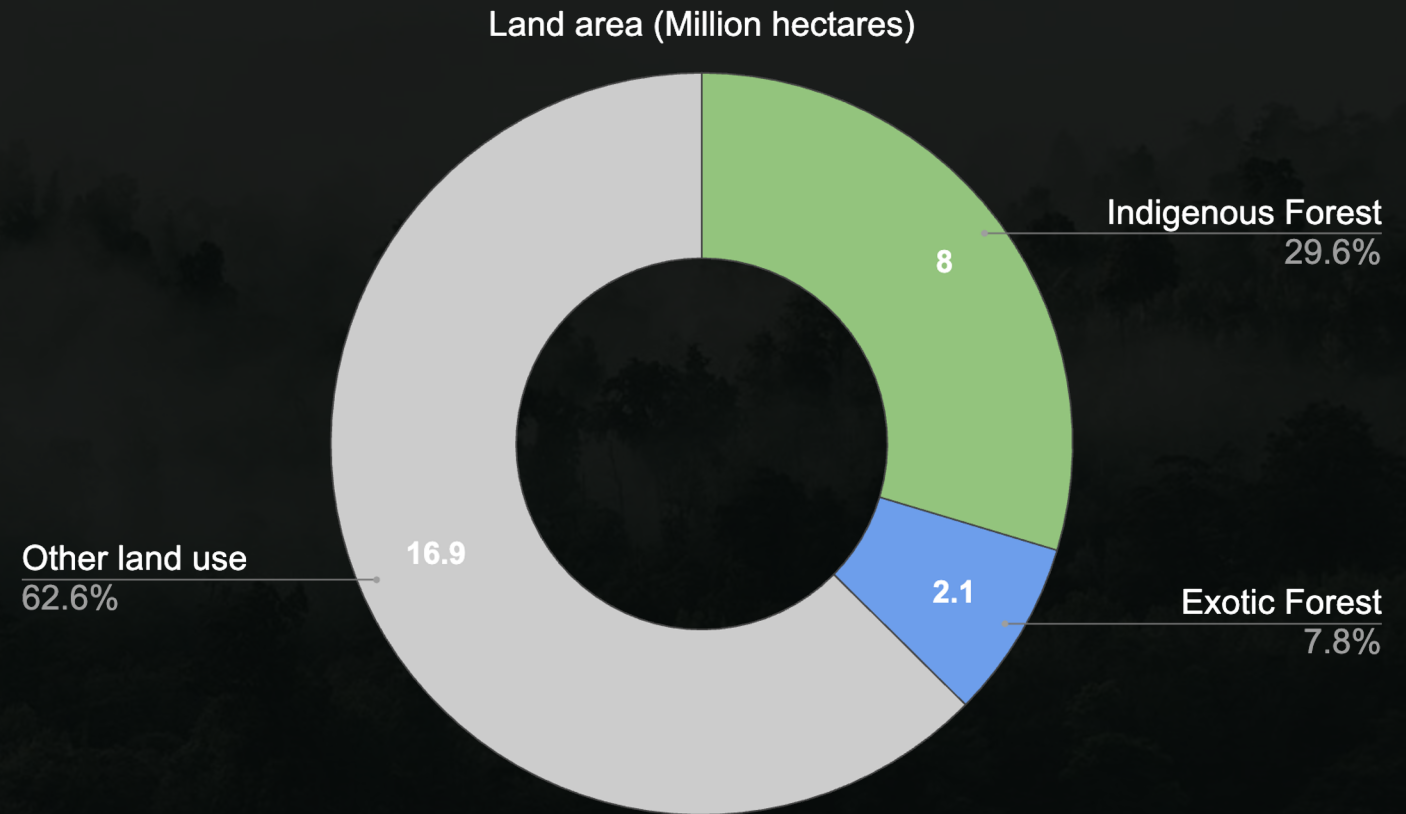This approach is repeatable across other regions.

NZ is a *consumer* member of the ITTO

But NZ *also* has significant domestic *temperate* forest area.

Land area (Million hectares)

Indigenous Forest
29.6%

8

Other land use
62.6%

16.9

2.1

Exotic Forest
7.8%

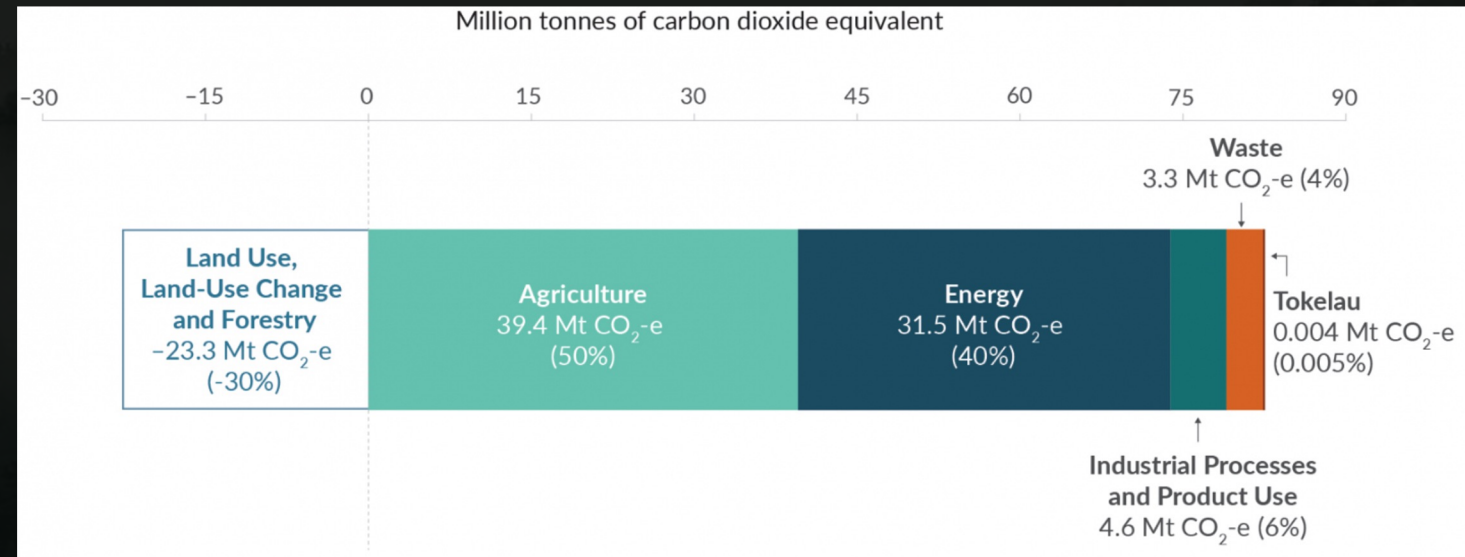Like all nations, NZ's forest is both a responsibility and an opportunity.

NZ NDC
- 50% below 2005 by 2030
- Total 2021–2030 budget: 571MT CO2e (vs 802MT baseline)

NZ strategy to achieve NDC:
- Domestic emissions reductions
- Domestic carbon sequestration in forest
- Offshore purchases of emissions mitigation outcomes

LULUCF is currently a 23.3Mt CO2e Carbon Sink.

Incentives should maintain and increase this.

Million tonnes of carbon dioxide equivalent

−30	−15	0	15	30	45	60	75	90

Land Use, Land-Use Change and Forestry
−23.3 Mt CO_2-e (-30%)

Agriculture
39.4 Mt CO_2-e (50%)

Energy
31.5 Mt CO_2-e (40%)

Waste
3.3 Mt CO_2-e (4%)

Tokelau
0.004 Mt CO_2-e (0.005%)

Industrial Processes and Product Use
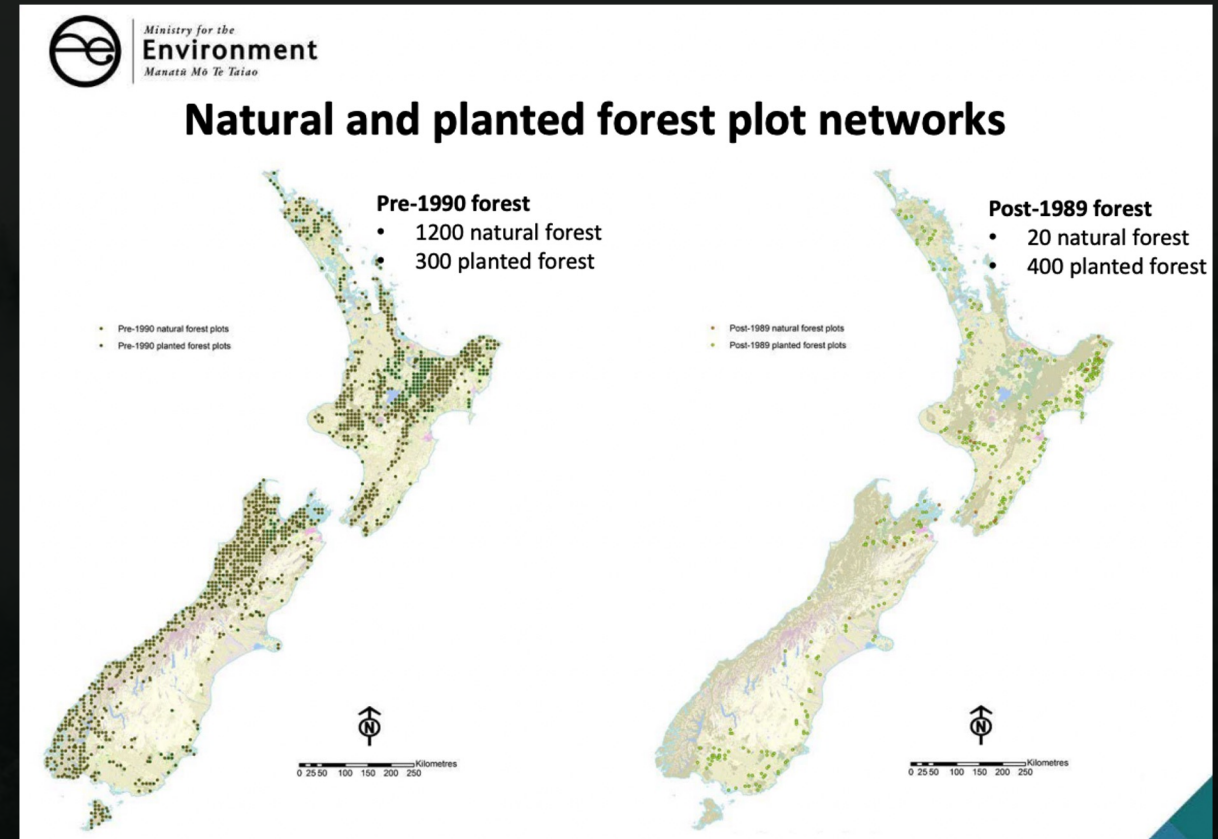4.6 Mt CO_2-e (6%)

2020 Emissions by Sector

100% of NZ Forest estate is 'managed forest' for purposes of UNFCCC, monitored nationally.

For NDC Accounting:
- Land in forest Pre-1990: Changes in carbon stock are credited vs *'reference level'*.
- Land established as forest Post-1989: All changes in carbon stock are credited.

Progress means:
- Managing pre-1990 forest cover to maximise carbon stock, minimise deforestation.
- Managing and extending Post-1989 forest cover to maximise carbon stock.

Ministry for the
Environment
Manatū Mō Te Taiao

Natural and planted forest plot networks

Pre-1990 forest
- 1200 natural forest
- 300 planted forest

Pre-1990 natural forest plots
Pre-1990 planted forest plots

Post-1989 forest
- 20 natural forest
- 400 planted forest

Post-1989 natural forest plots
Post-1989 planted forest plots

Kilometres
0 25 50 100 150 200 250

Kilometres
0 25 50 100 150 200 250

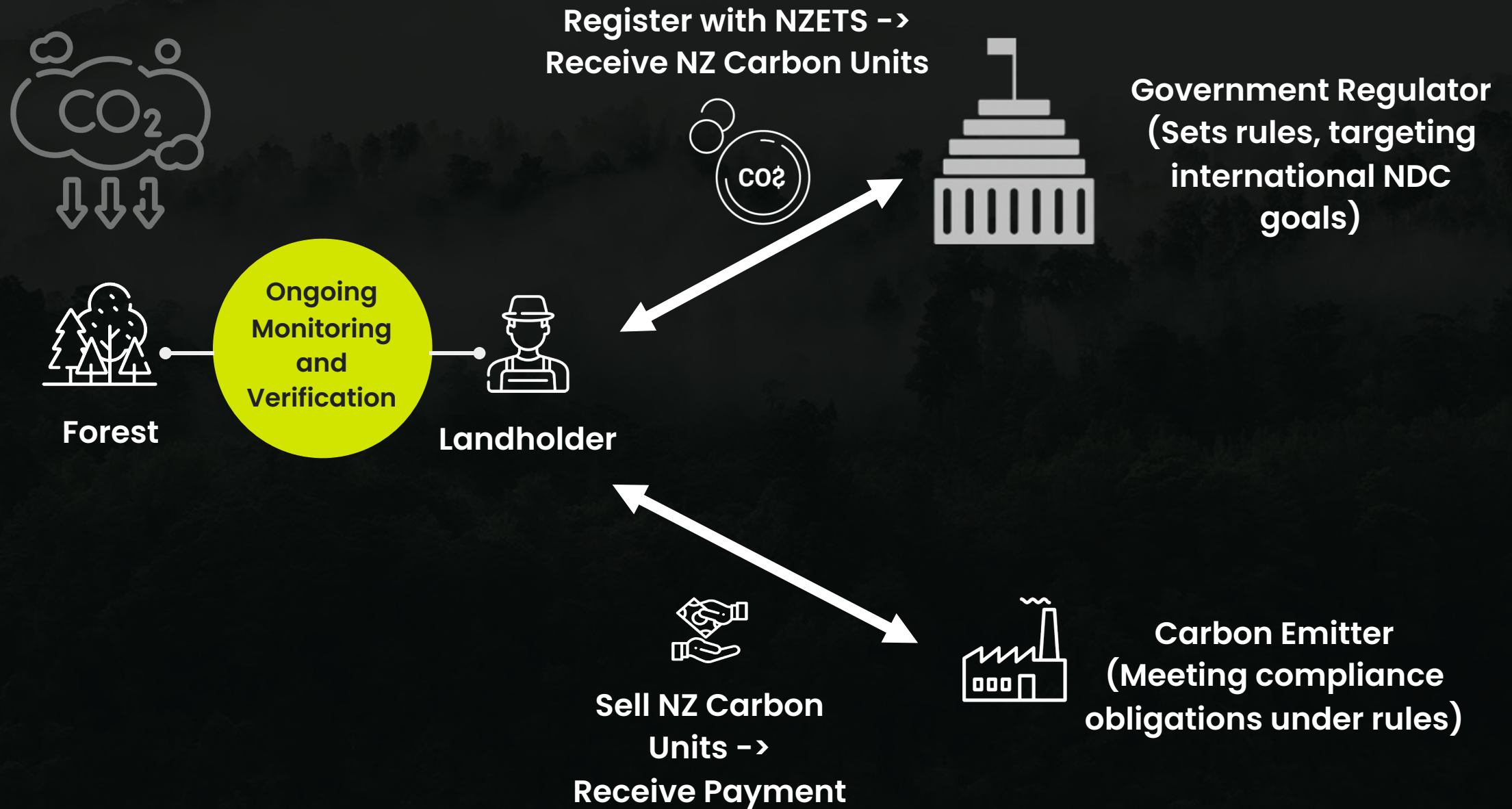# Incentivising these outcomes requires two key elements

Robust framework for recognising the forest carbon sequestration outcomes which land or forest owners achieve.

A market that provides a way to turn sequestration outcomes into money to drive economic response.

ETS For Foresters: Private landholders represent the majority of the opportunity

CO₂

Register with NZETS -›
Receive NZ Carbon Units

CO₂

Government Regulator
(Sets rules, targeting
international NDC
goals)

Ongoing
Monitoring
and
Verification

Forest

Landholder

Sell NZ Carbon
Units -›
Receive Payment

Carbon Emitter
(Meeting compliance
obligations under rules)

Approximately 400,000 ha
Post-89 forest registered.

Estimated ~13Million tons CO2
sequestration in 2022 US$600Mil
at current prices.

This represents a success, but also a failure.

Only 55% of estimated eligible forest is enrolled.

Mixed land use participants have the **most** potential to increase sequestration... but also have the **lowest** engagement rates

Indigenous biodiverse forests are the **highest** policy priority... but have the **lowest** registration rates, and are under-incentivised.

Complexity of registration and compliance processes

Uncertainty around carbon yields and monitoring processes

Most prevalent for:
- Forest on areas of mixed land use
- High biodiversity forest with large variety of mixed species representation.
- Mixed management forest

Solutions through Remote Sensing, Artificial Intelligence, and Automation

Multiple Remote Sensing Data Sources (Satellite, Aerial, Hyperspectral, Digital Elevation Model)

+
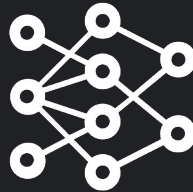
Deep Neural Networks -› Vegetation classification and parameters

+

Automated 'Rules Engine' -› Evaluate UNFCCC 'forest' criteria

+

Land ownership and boundary information -› Give forest owners a *customised* assessment

Core technology: Vegetation assessment

Species + **Height** + **Density** + **Growth over time**

Species differentiation and clustering

Multiple data sources determine the most probable species mix based on ground truth points.

Extensible to arbitrary species combinations

Ground truth
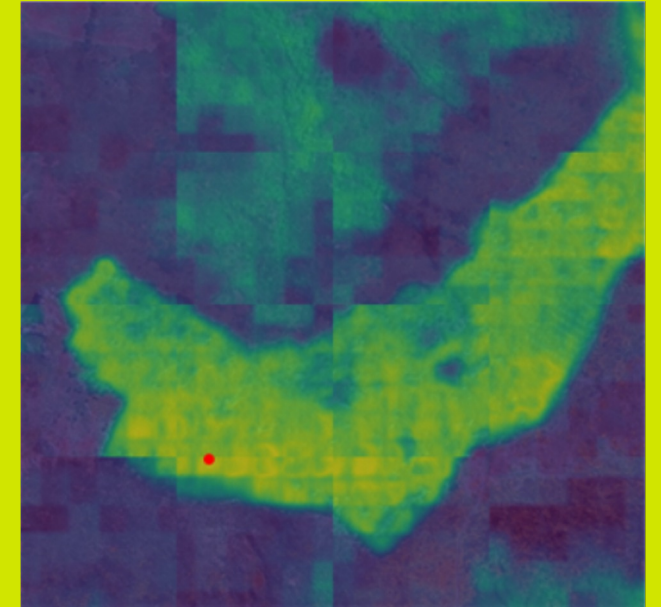
Pine activations
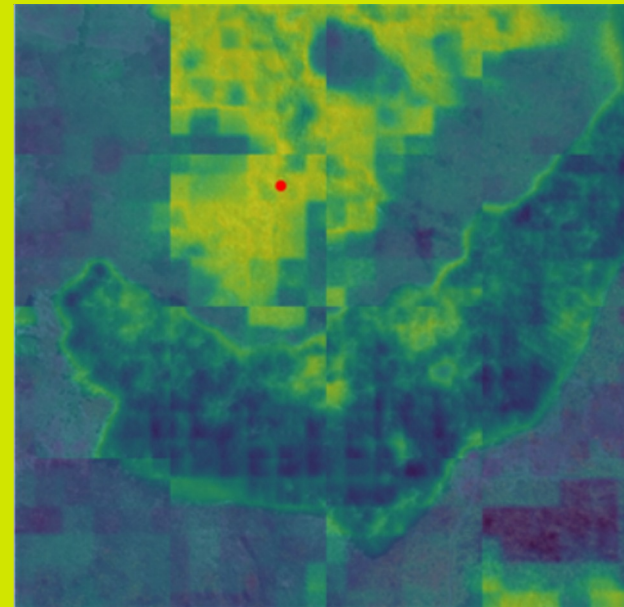
Indigenous activations
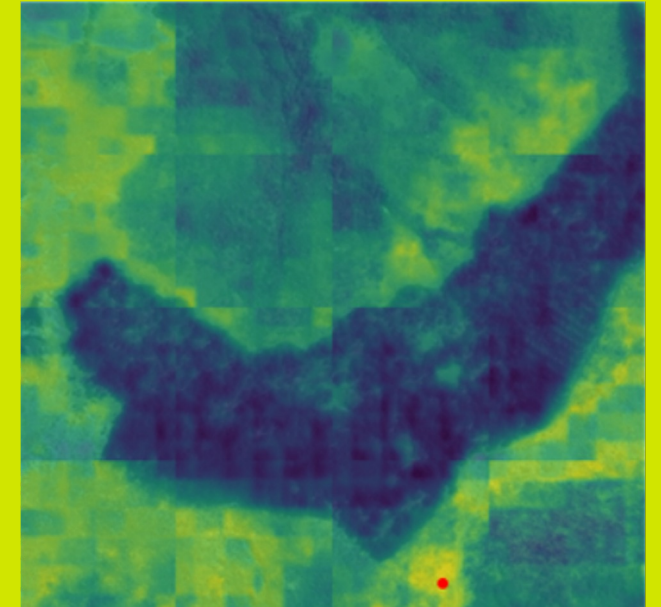
Gorse activations

Vegetation Boundaries

Segment individual patches of vegetation by class.

Gives 'Raw' vegetation state -> Then apply regionally appropriate UNFCCC rules

EX 1

EX 2
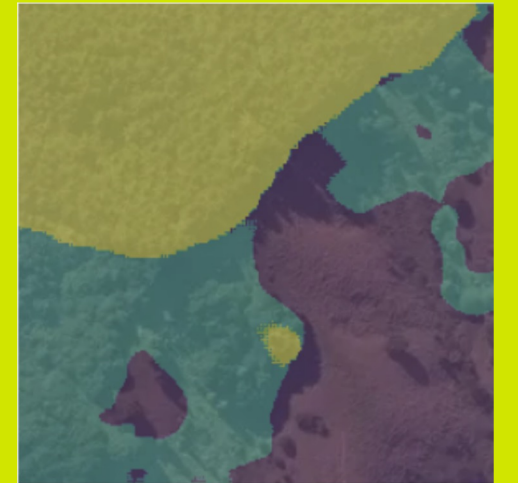
>92% Pixel level accuracy across target vegetation classes

From 'Vegetation' to 'Forest'

In NZ, Forest under UNFCCC is

- >1ha
- >30m average width
- >30% canopy cover
- >5m high at maturity

Vegetation aggregates which meet these criteria contribute to carbon inventory.

Bridging Gaps

Simplification
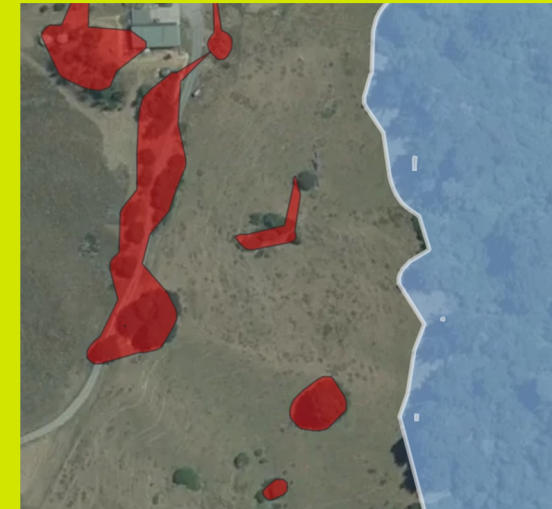
Determine Eligibility

Carbon Stock + Sequestration Estimation

Carbon Units are issued based on standard species-group carbon stock and sequestration rate tables.

These are calibrated with a national monitoring network

Custom rates for large forests

Ministry for the **Environment** *Manatū Mō Te Taiao*

Natural and planted forest plot networks

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· Pre-1990 natural forest plots
· Pre-1990 planted forest plots

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· Post-1989 natural forest plots
· Post-1989 planted forest plots

0 25 50 100 150 200 250 Kilometres

0 25 50 100 150 200 250 Kilometres

CarbonCrop are developing high resolution carbon stock + sequestration profiles from standard remote sensing data.

This integrates:
- Our species cluster similarity metrics.
- Existing allometric models.
- Existing ground truth calibration data.
- Ongoing field measurement data.
- An expanding set of environment data

Carbon Stock

Carbon Sequestration
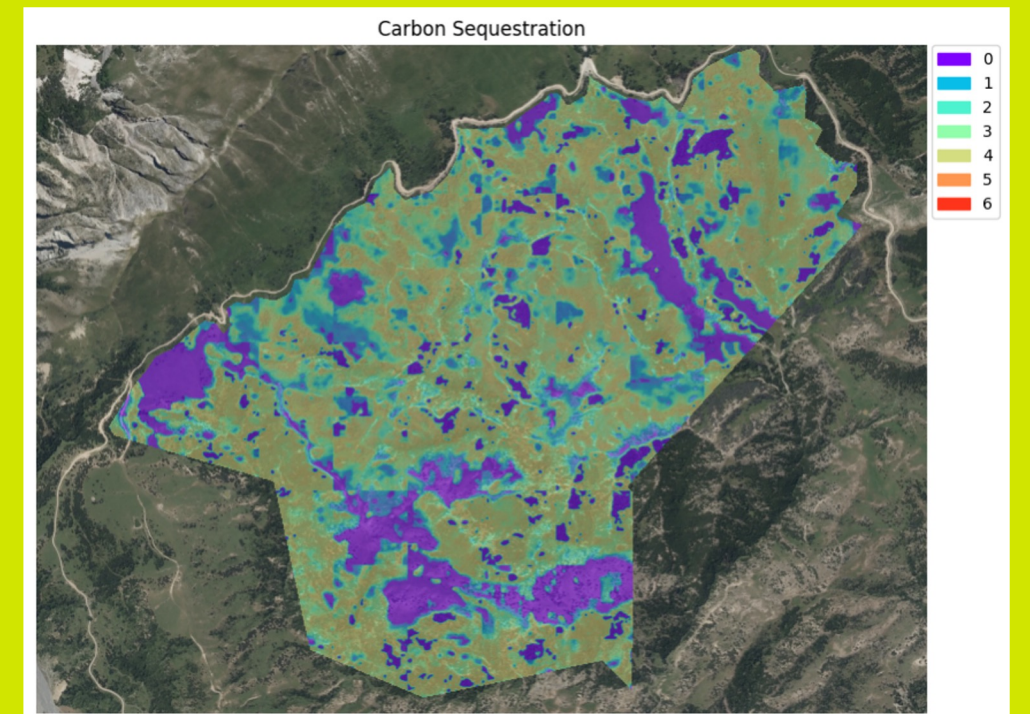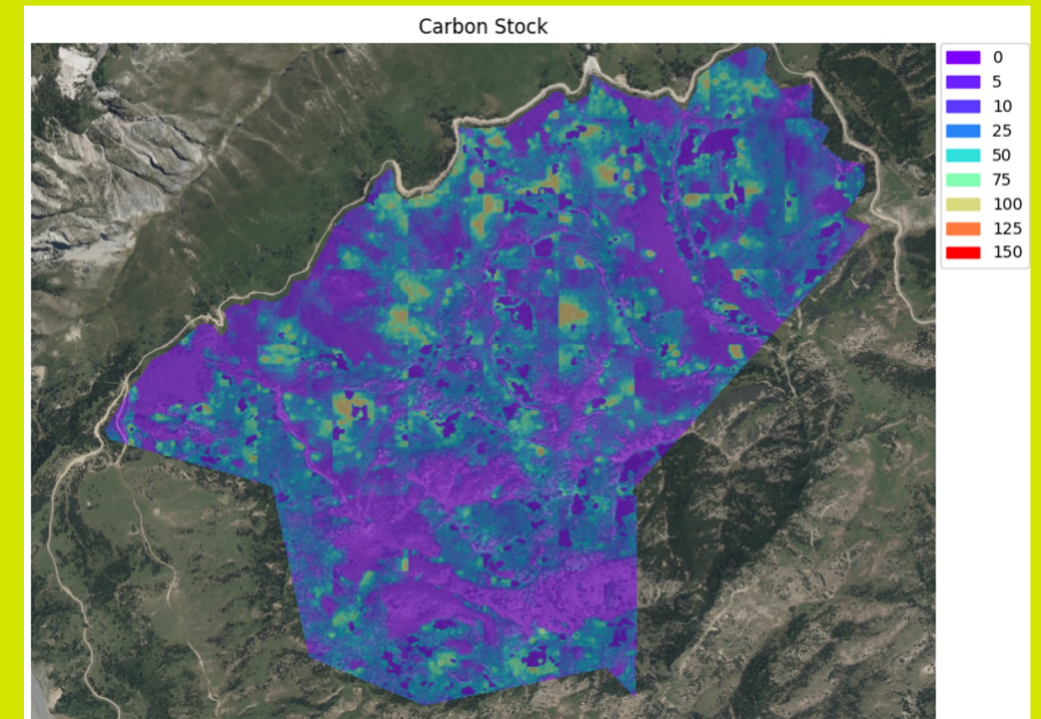
Like our species model, this approach can be applied across regions.

It requires an initial approximate allometric model for the forest categories to be monitored.

It is specifically designed to integrate additional monitoring data over time to improve accuracy.

Carbon Stock

Carbon Sequestration
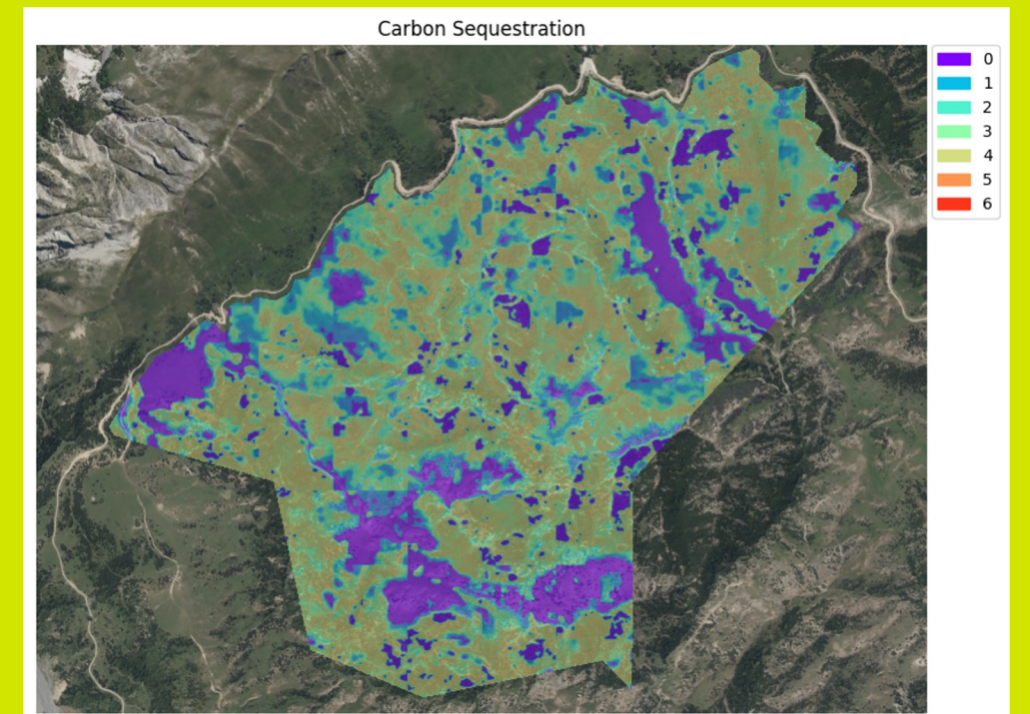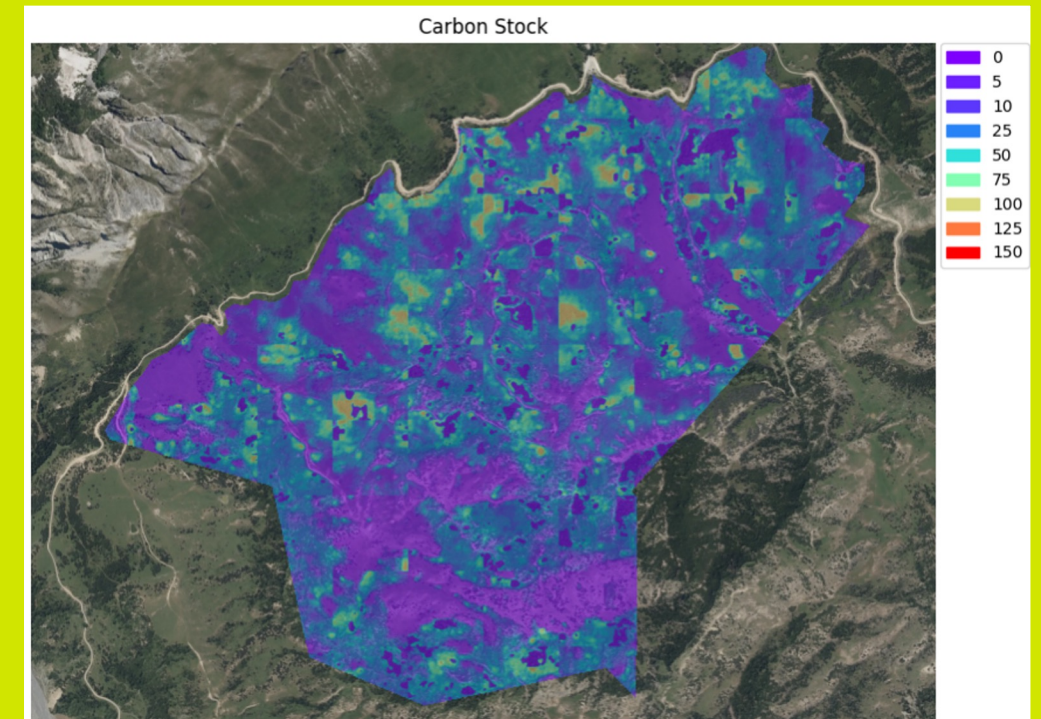
Scalable Markets Require: Integrity
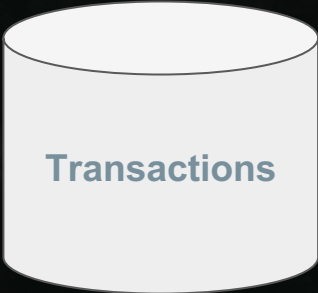
3 Key elements

| Transparency | Traceability | Auditability |

-> National Market Integrity
-> International Market Integrity

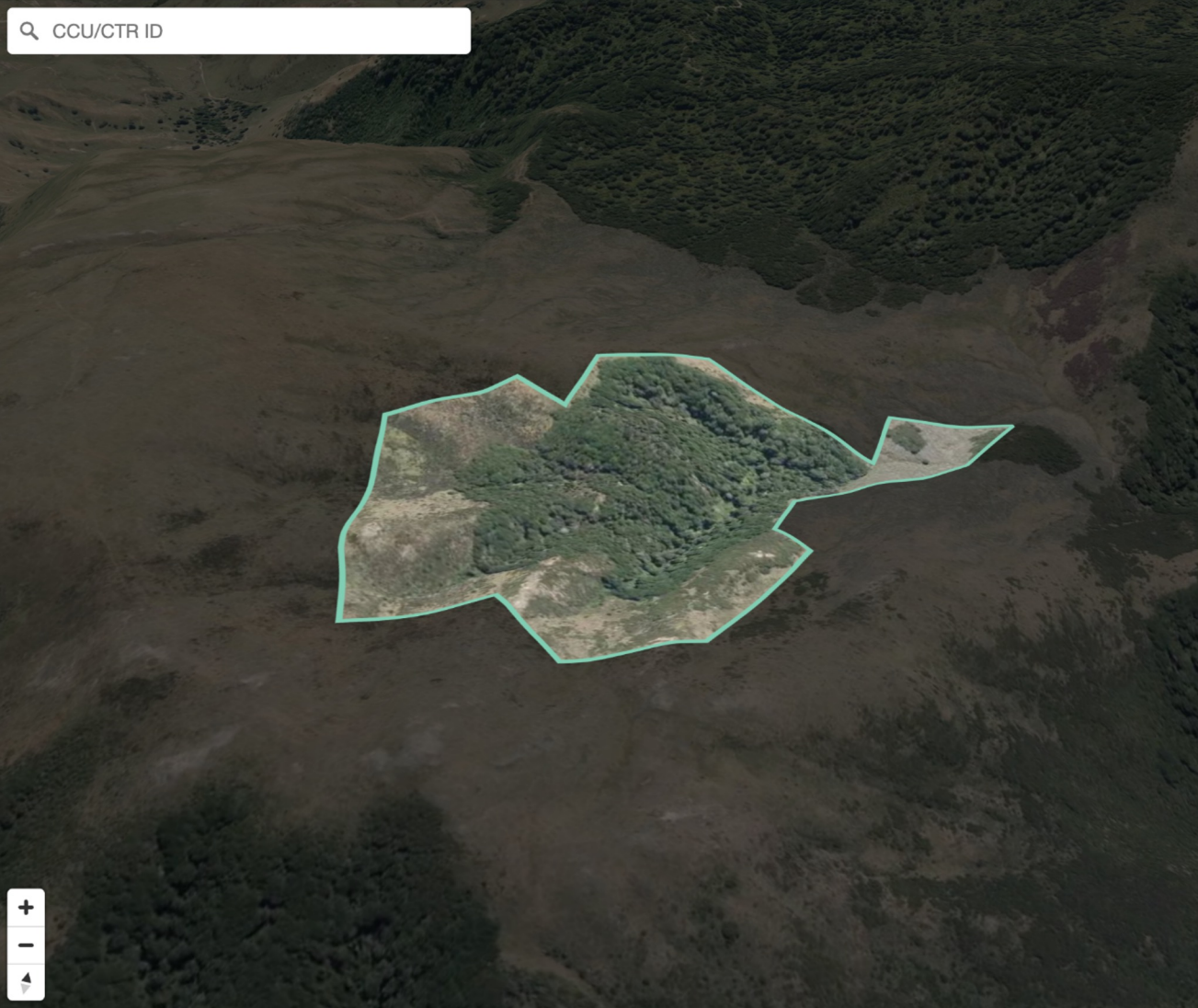# Implementation example - Native CarbonCrop Units - Voluntary Carbon Market Solution

Carbon Unit
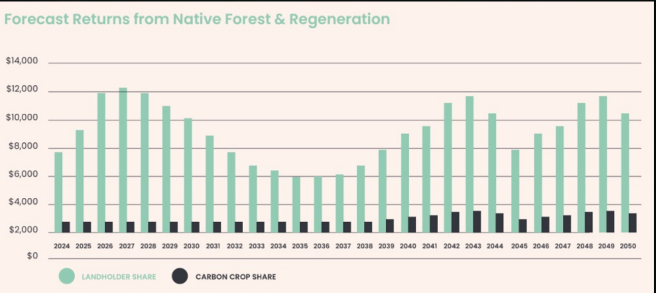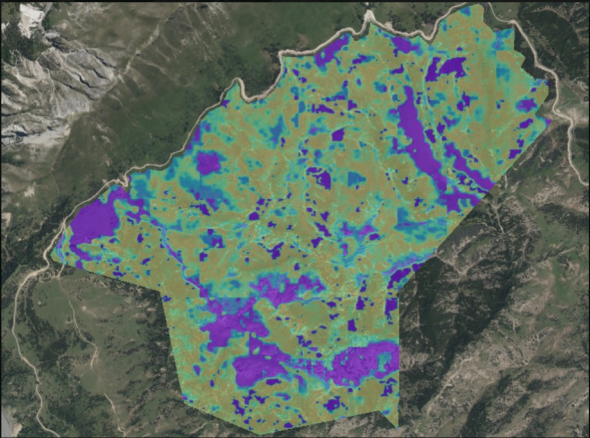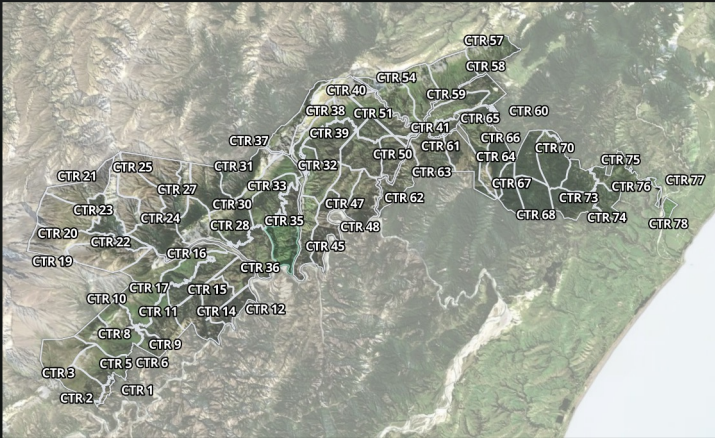
sequestrationYear: 2019
id: 66426
location: -44.544136, 169.3247105
issuer: CarbonCrop
type: indigenous biodiverse forest

Issuance

Ownership

Transactions

Integrations
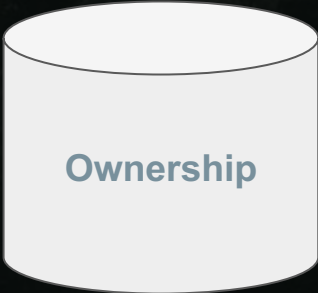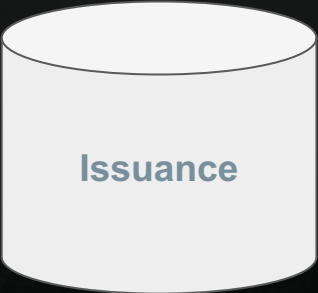
Carbon offset buyers need to be able to verify claims

Scalable Markets Require: Accessibility

Forest owner reports are generated automatically from vegetation data.

Online tooling - Simplify collaboration, reporting, and compliance.
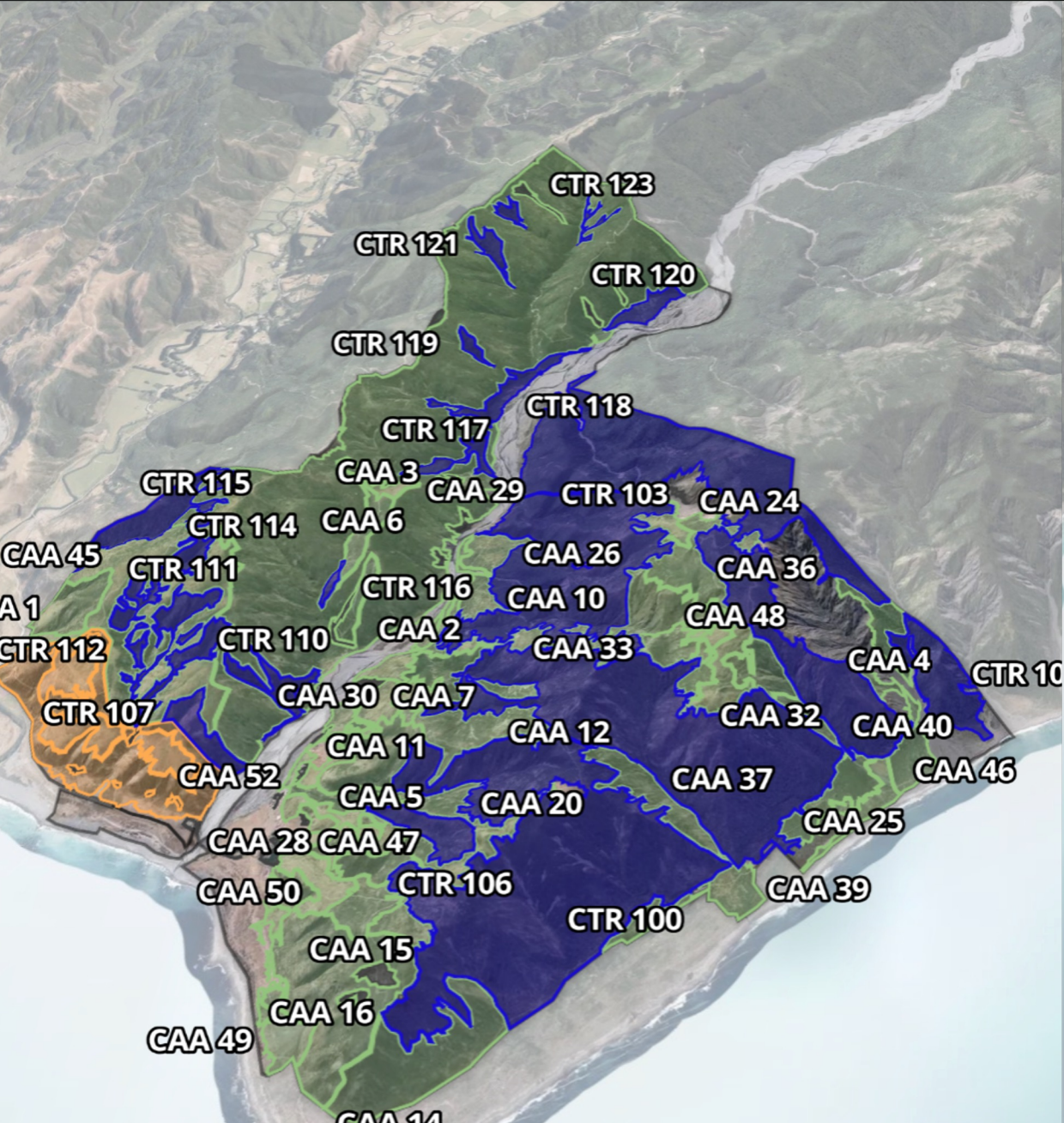
Project 1515

About   Map   Edit   Tools   **Financials**   Comments

This project has CTRs   Calculate CCUs

Carbon yield:	8,287 tonnes / year
Landowner:	$13,167,119 NPV of cashflows to 2050
CarbonCrop:	$1,009,406 NPV of contract to 2033 Existing Forest Only

Project terms

Contract length	10	yrs
CarbonCrop share	10	%
Discount rate for NPV	7	%

1116 ha Indigenous forest credit sales

Landholder share   CarbonCrop share

7.9 ha Native planting forest credit sales

1 year from launch.
This approach has
had a positive impact
in New Zealand

CarbonCrop's solution has significantly increased market participation of biodiverse forest

Registered landowners

200

150

100

50

0

OCT 2021   DEC 2021   FEB 2022   APR 2022   JUN 2022

80%
native
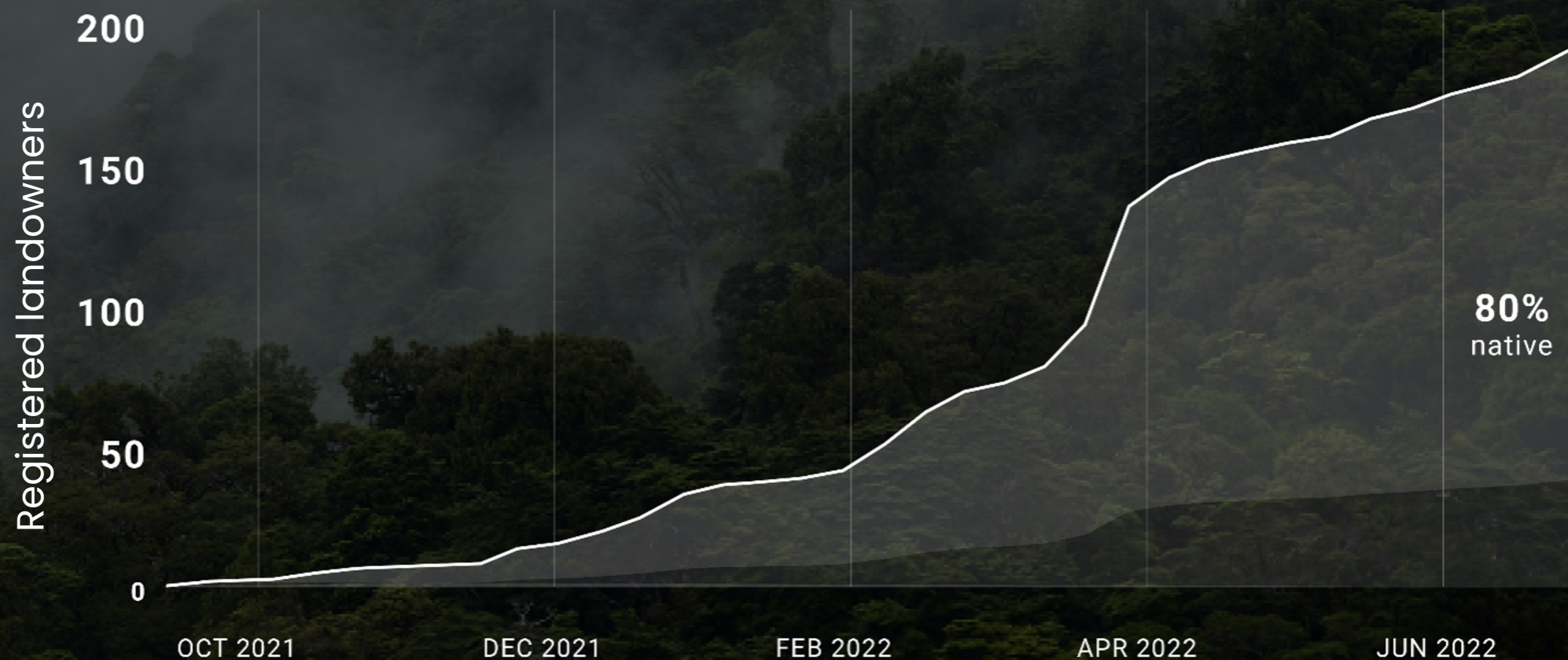
13,000+ ha added forest
$30,000,000+ to landholders for carbon

These **same technologies** can be applied to support **high integrity** forest carbon markets in **any region**

CarbonCrop

We welcome the opportunity to **collaborate** with ITTO and any Member Country to develop **solutions for tropical forest**

CarbonCrop

Thank you

CarbonCrop

https://carboncrop.nz
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