# A Framework for Analysing Forest Ecosystem Services

**R Yao, D Harrison, J Monge & S Velarde**

Scion Research, NZ

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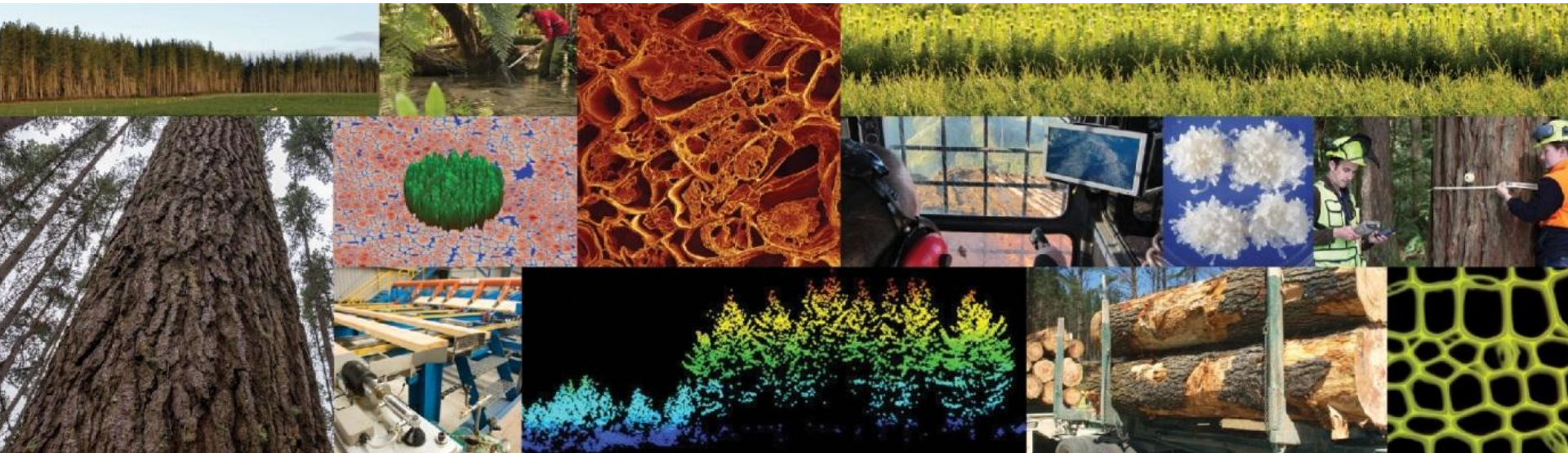
2014 NZARES Conference
28-29 August 2014, Nelson, New Zealand

# Outline

- Planted forests and ecosystem services
- The framework and its previous application
- What is the project about?
- Example results – Ōhiwa catchment
- Discussions
- Project timeline

Northland Region

Auckland Region

Waikato Region

Bay of Plenty Region

Gisborne Region

Taranaki Region

Hawke's Bay Region

Manawatu-Wanganui Region

Wellington Region

Nelson Region

Tasman Region

Marlborough Region

West Coast Region

Canterbury Region

Otago Region

Southland Region
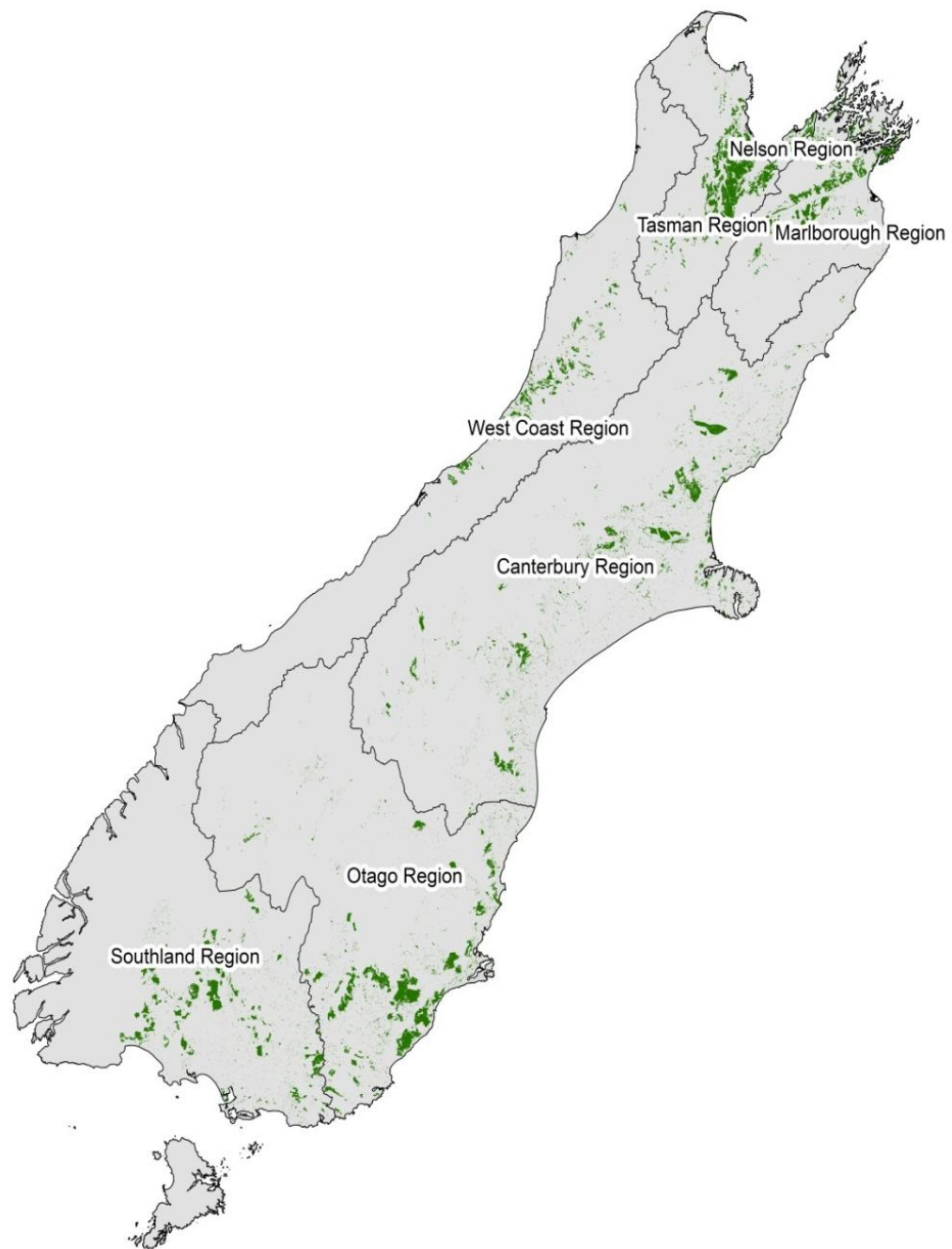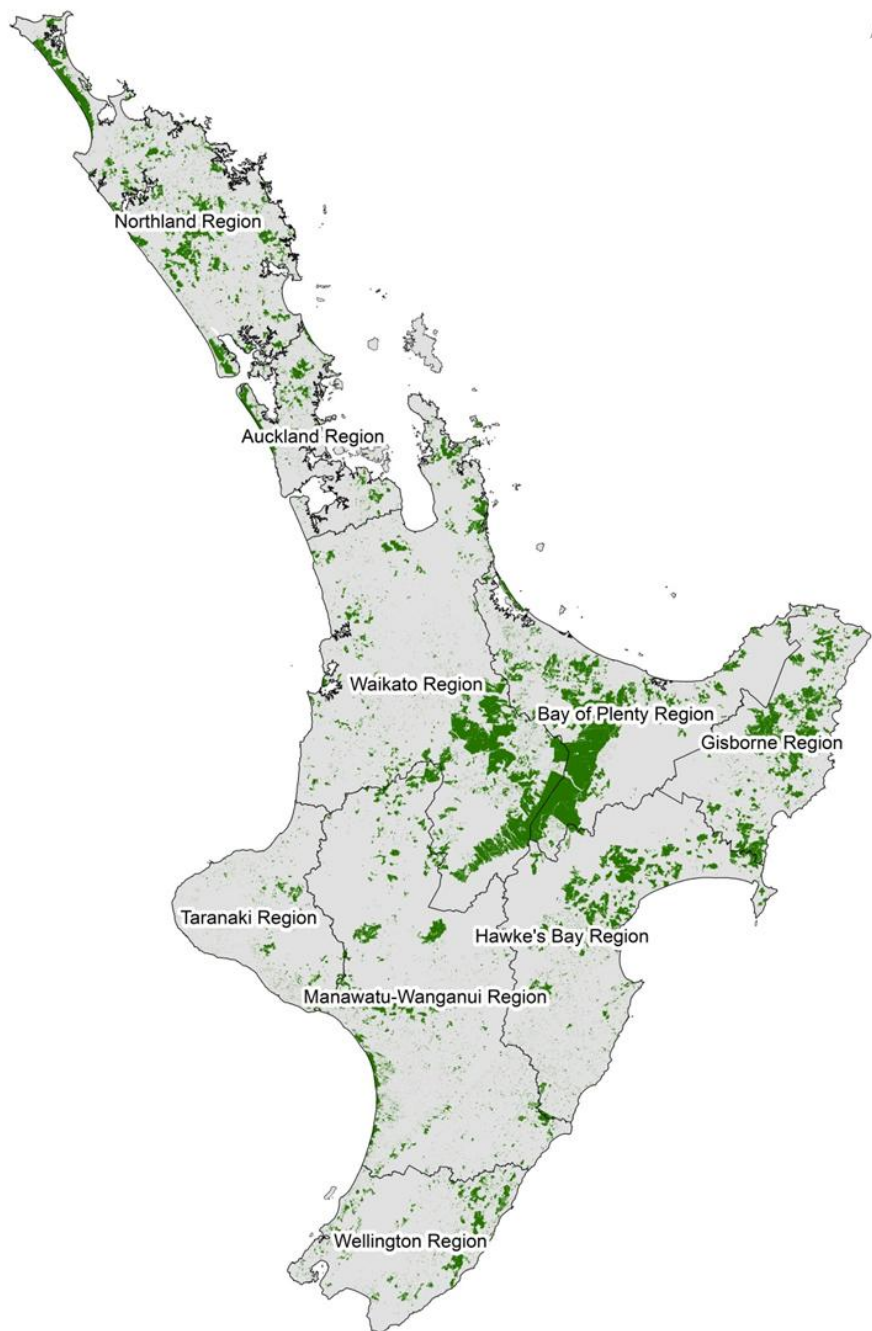
# Forest Ecosystem Services

- Ecosystem services are the benefits derived by people from ecosystems

- Planted forests are mainly recognised for the provision of forest products (Yao et al. 2013)

- Increasingly recognised for:
  - Carbon (Barry et al. 2014)
  - Avoided erosion (Barry et al. 2014)
  - Biodiversity (Yao et al. 2014)
  - Recreation (Dhakal et al. 2012)

# The spatial economic framework

- "Where can I establish new forests?"
  - Combines spatial, economic and environmental data
  - Identifies areas where new forests would be economically viable

- Quantifies environmental benefits:
  - Carbon sequestration
  - Avoided sedimentation
  - Flood mitigation

- Estimated the values of afforesting 2.5 million ha of NZ marginal land
  - Timber, C and avoided erosion

Barry LE, Yao RT, Harrison DR, Paragahawewa UH, Pannell DJ 2014 Enhancing ecosystem services through afforestation: How policy can help. Land Use Policy 39: 135-145.

# Forest Investment Finder

## 1. Spatial data



300 Index, Site Index, Temperature

Slope, Soil, Land Cover, Other Impedances
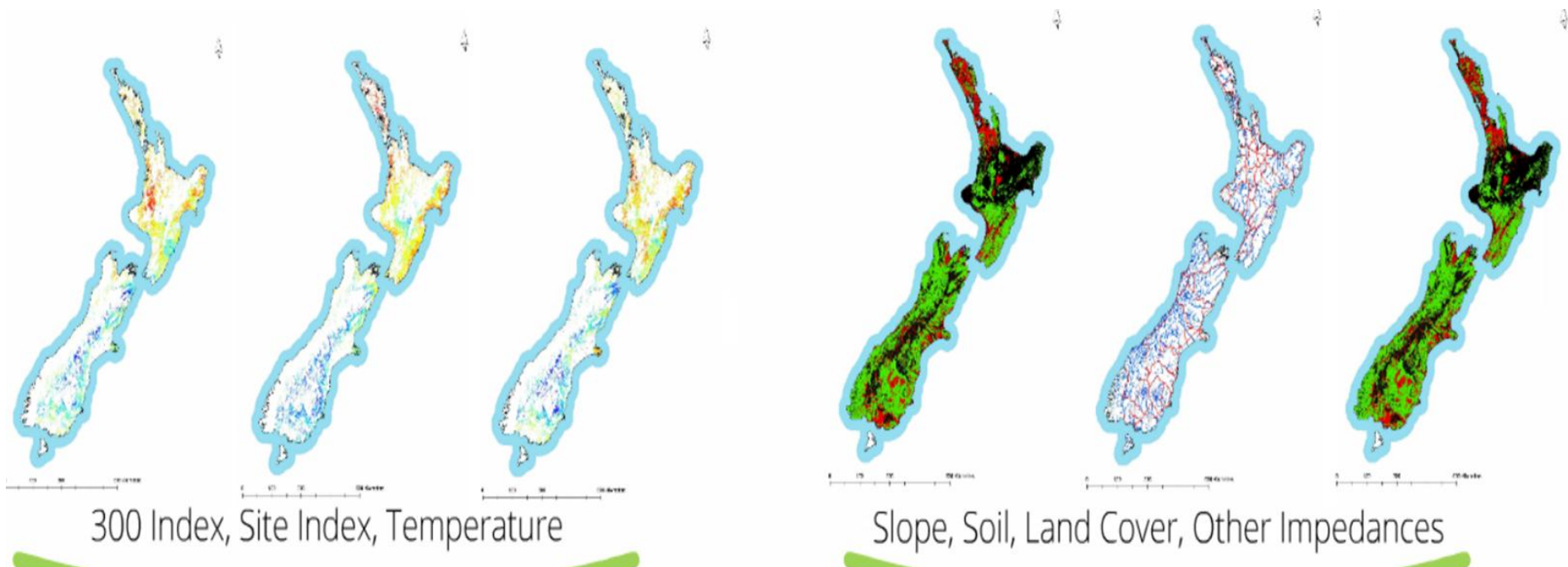
# 2. Economic Data



- Costs
  - Land value ($/ha)
  - Establishment and thinning ($/ha)
  - Roading and landing construction ($/ha)
  - Harvesting and transport ($/ha)
  - Forest management ($/ha)
  - Carbon admin ($/ha)

- Revenues
  - Timber: P1, P2, S1, S2, S3, Pulp ($ per $m^3$)
  - Carbon ($ per tonne of $CO_2$-e)
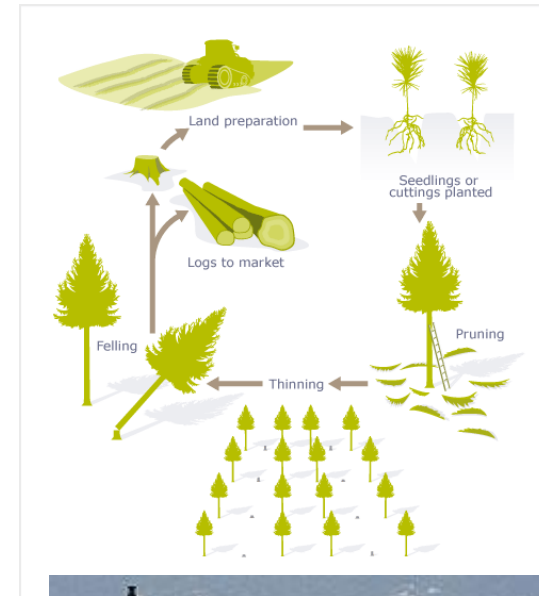
# 3. Environmental Data
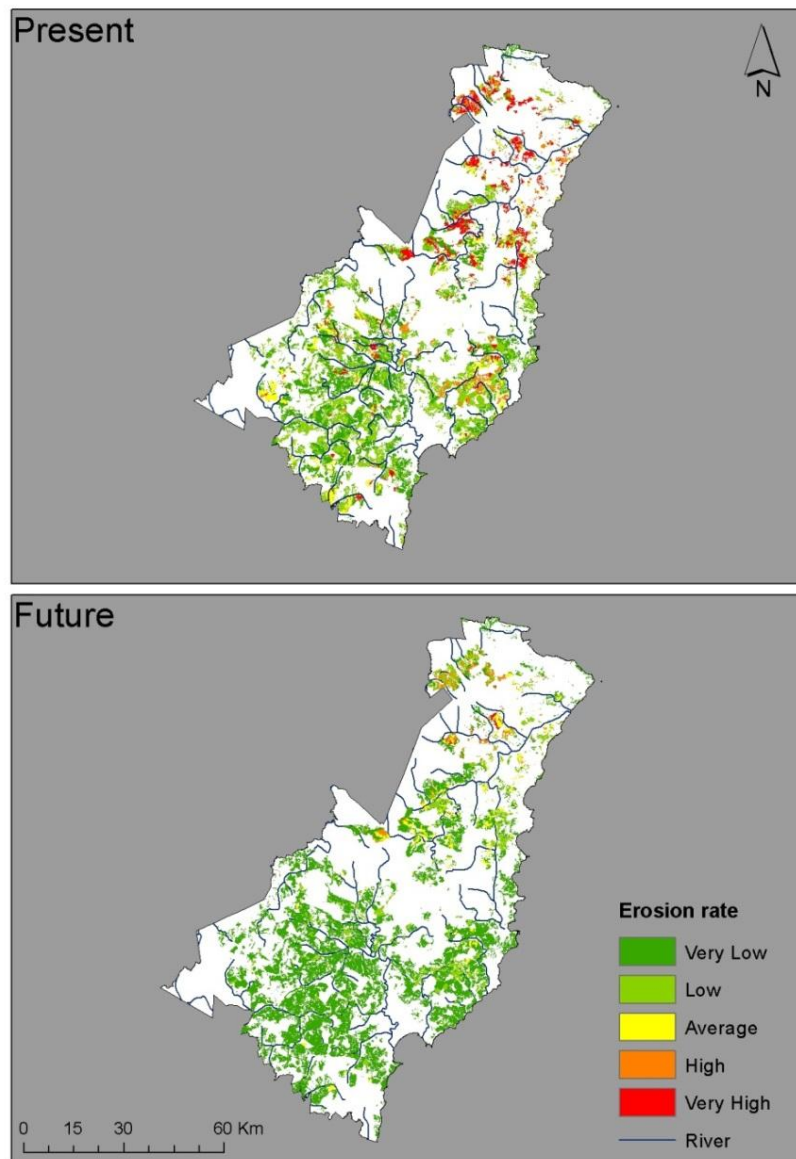


- Avoided soil erosion – using New Zealand Empirical Erosion Model (NZEEM)

- After afforestation, soil erosion rate diminishes (Fahey and Marden 2006)

- Reduction in the sedimentation of water ways
  - $5.50/tonne in avoided water treatment cost
  - $0.90/tonne in avoided flood damage

profit or loss

Legend
- $< -\$2000$
- $-\$2000 - -\$1500$
- $-\$1500 - -\$1000$
- $-\$1000 - -\$500$
- $-\$500 - \$0$
- $\$0 - \$500$
- $\$500 - \$1000$
- $\$1000 - \$1500$
- $\$1500 - \$2000$
- $< \$2000$

0 62.5 125 250 375 500
Kilometers

0 5 10 20 30 40
Kilometers

avoided erosion
loss

Legend

Action
- Extension
- No Action
- Positive Incentives

0 125 250 500 750 1,000
Kilometers

0 5 10 20 30 40
Km
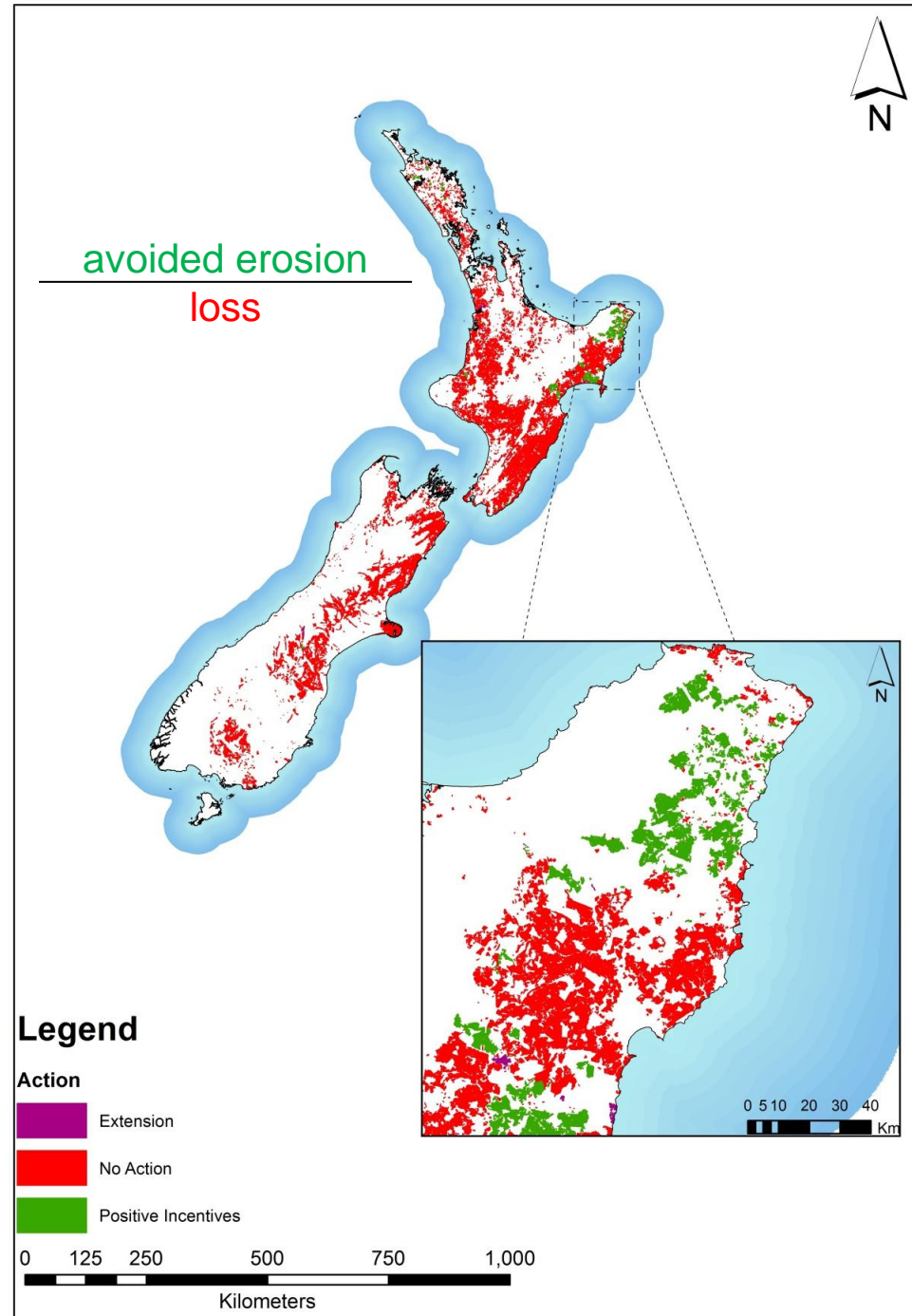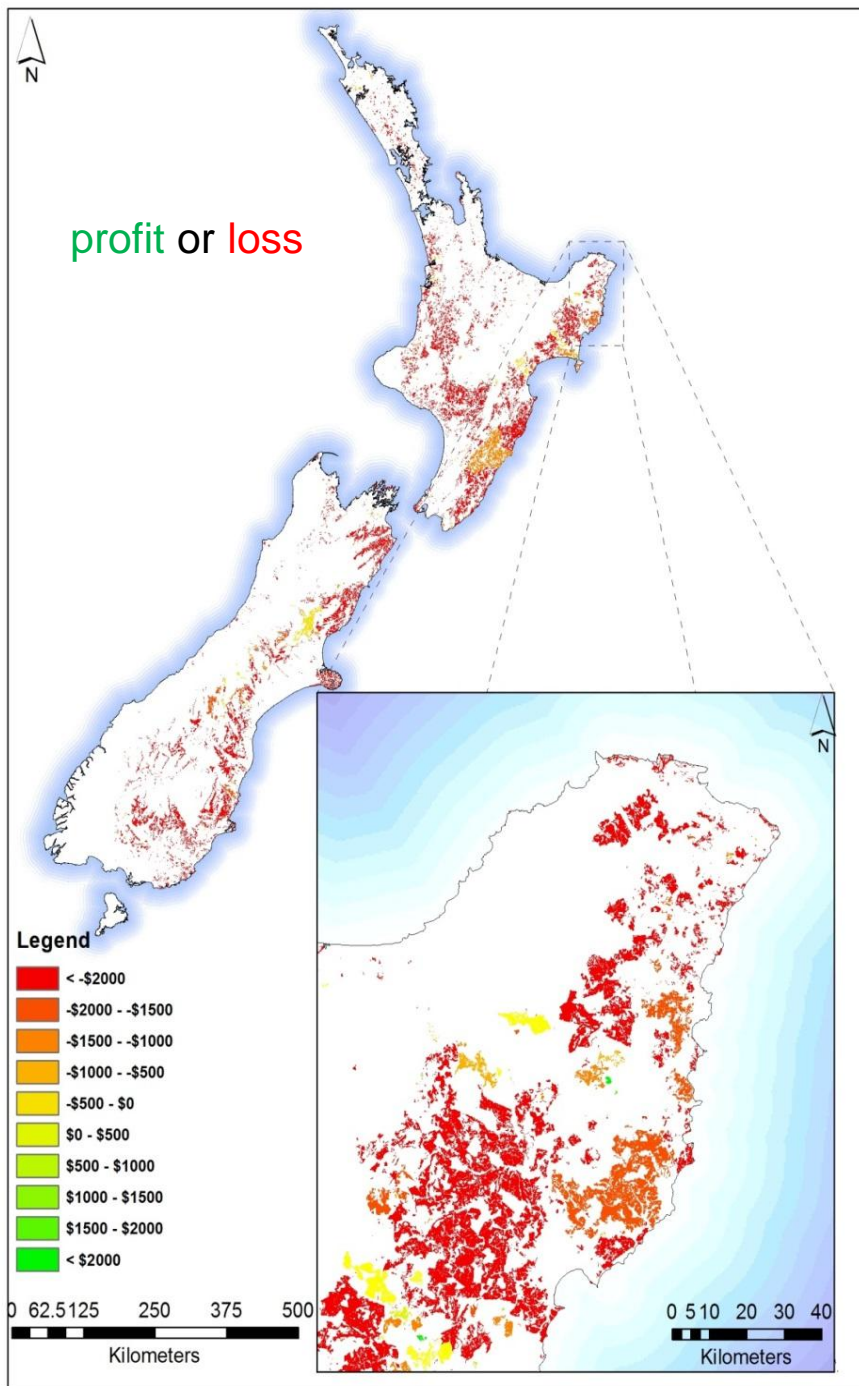
# Ecosystem Services Provided by Planted Forests

**Ecosystem Processes**

**Supporting**
• Nutrient cycling
• Soil formation
• Primary production

**Ecosystem Services**

**Provisioning**
• Timber
• Understorey crops
• Freshwater
• Biofuel

**Regulating**
• Carbon sequestration
• Avoided sedimentation
• Flood mitigation
• Avoided N

**Cultural**
• Recreation
• Species conservation
• Educational
• Spiritual

**Attributes**

**Security**
• Personal safety
• Secure resource access
• Security from disasters
• Employment

**Basic material for the good life**
• Adequate livelihoods
• Timber
• Shelter

**Health**
• Strength
• Feeling well
• Access to clean air and water

**Social relations**
• Social cohesion
• Mutual respect
• Ability to help others

**Freedom of choice and action**
Opportunity to be able to achieve what an individual values doing and being

Adapted from MEA (2005) and Yao et al. (2013)

# What is the project about?

- The framework is applied on existing forests
- Invited forest companies to participate
  - forests with compartments that have been harvested
  - collect financial data from forest companies
  - S (0.8k-4k ha), M (4k-10k ha), L (>10k ha)
    - scale effects - differences in cost and revenue estimates
  - profits will be reported in "index" form
- For each case study, we will estimate 4 ES values (timber, C, flood mitigation, avoided sedimentation)
- Explore the development of new ecosystem services value layers:
  - **biodiversity (Yao et al. 2014, Yao et al. 2012)**
  - **recreation (Dhakal et al. 2012, Yao et al. 2013)**
  - avoided N (Smaill et al. 2011)

ELSEVIER

Analysis

# Valuing biodiversity enhancement in New Zealand's planted forests: Socioeconomic and spatial determinants of willingness-to-pay ☆

Richard T. Yao [a,*], Riccardo Scarpa [b,f], James A. Turner [c], Tim D. Barnard [a], John M. Rose [d], João H.N. Palma [e], Duncan R. Harrison [a]

Highlights

- Biodiversity in planted forests - valued by respondents (n = 209)
- A typical respondent would pay ~$50/year for a 5-year programme
- Results suggest higher values for conservation of birds
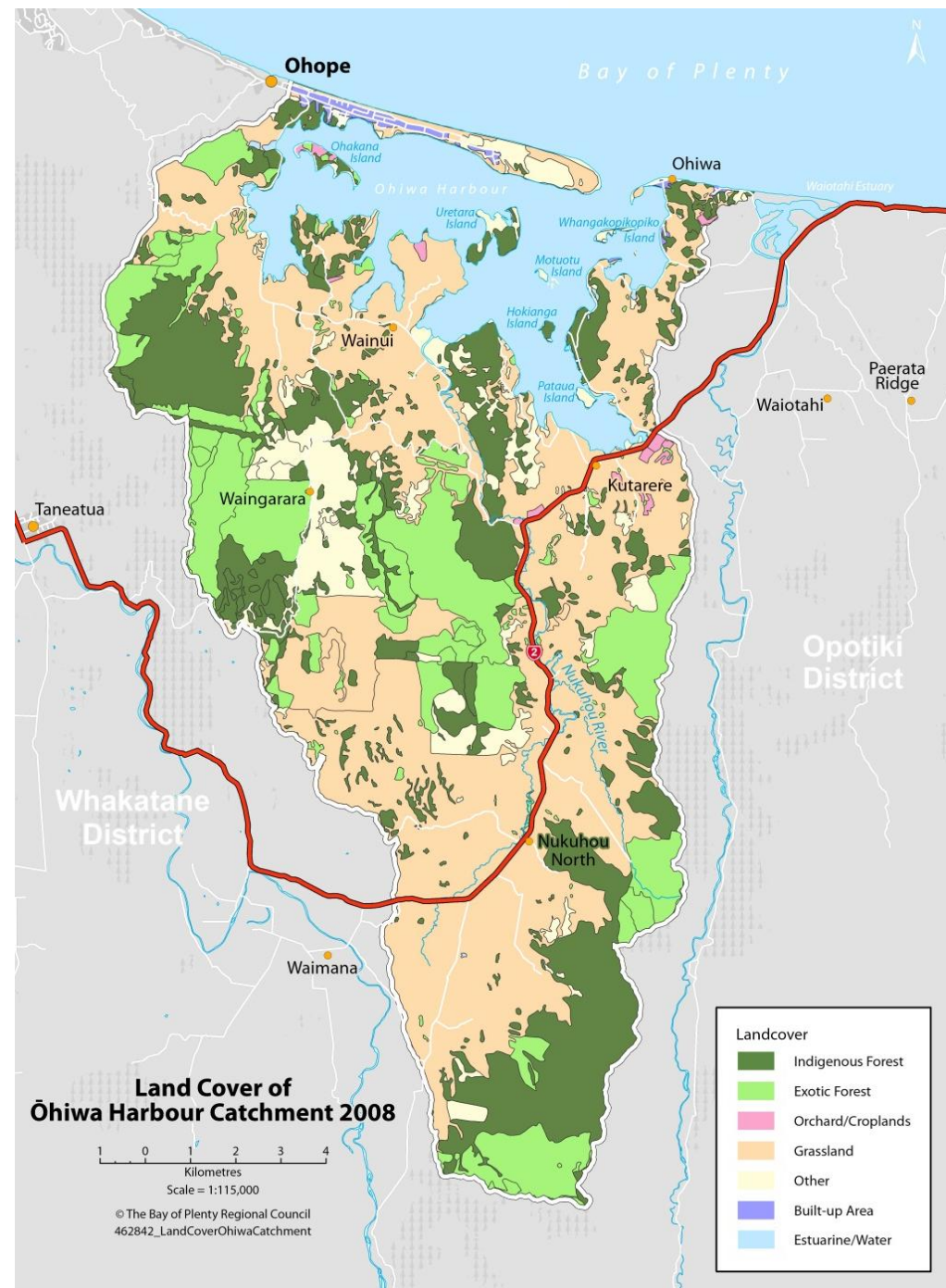- Close proximity to large planted forests positively affects the values

# Value of recreation in Whakarewarewa forest

- Value can be derived from
  - Cost of travelling to the forest
  - Time spent in the forest

- Economic survey (Travel cost)
  - Focus groups
  - Face to face survey of repeat users
  - 366 walkers and 340 mountain bikers

- Recreational value
  - Walking - $38 per visit
  - Mountain biking - $53 per visit

Dhakal B, Yao RT, Turner JA, Barnard TD 2012. Recreational users' willingness to pay and preferences for changes in planted forest features. Forest Policy and Economics 17: 34-44.
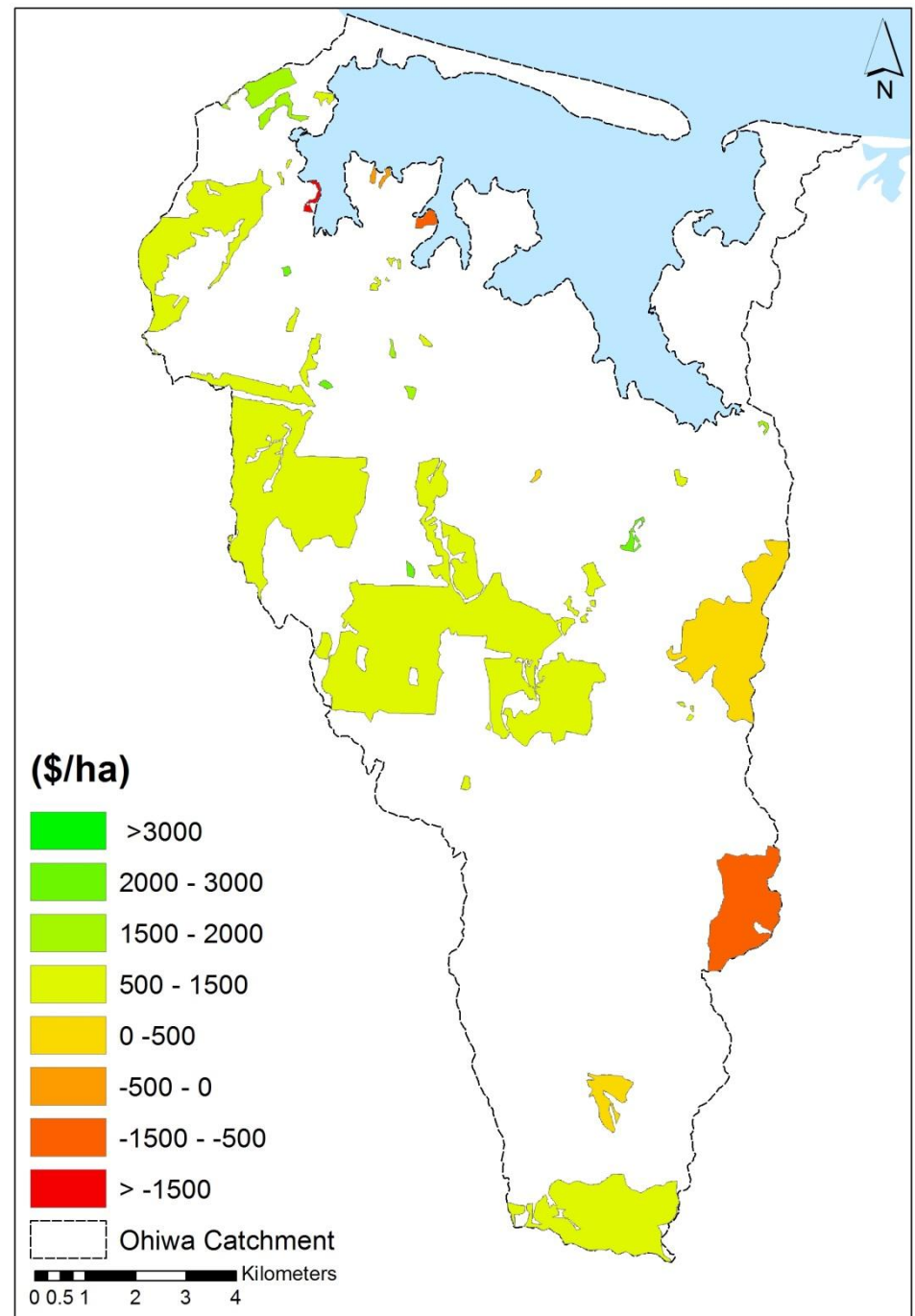
# Analysing ES for the Ōhiwa Catchment

- BOPRC (Jun-Nov 2014)
- Better understanding of ES values
  - milk, meat, timber, fruits
  - C sequestration, erosion
  - recreation, sp. conservation
- Estimate ES values of key land uses
  - Dairy, S&B, Horticulture
  - **Planted forests**
  - Native forests
- Greater visibility ES values in policy



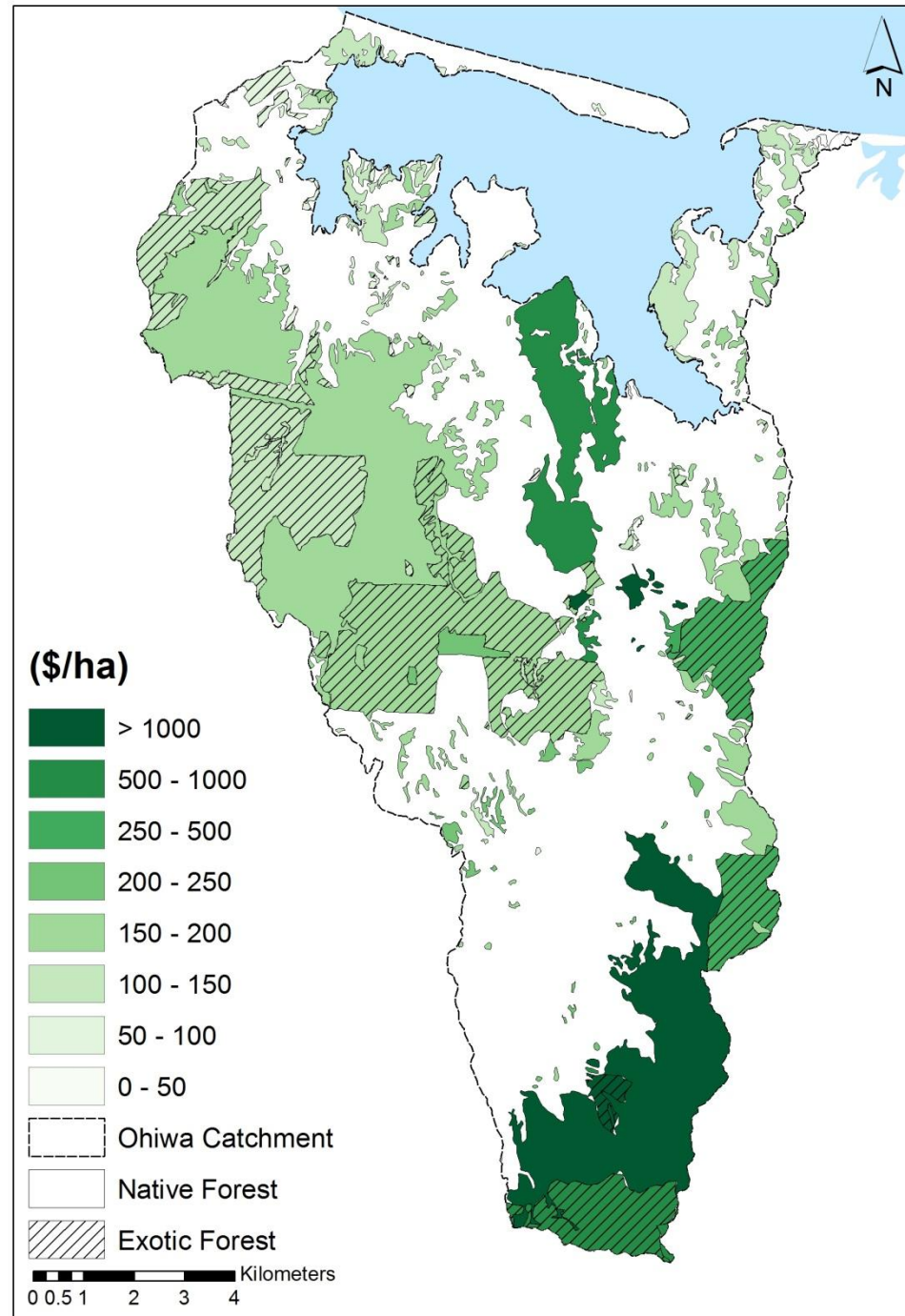Land Cover of Ōhiwa Harbour Catchment 2008

Kilometres
Scale = 1:115,000

© The Bay of Plenty Regional Council
462842_LandCoverOhiwaCatchment

Landcover
- Indigenous Forest
- Exotic Forest
- Orchard/Croplands
- Grassland
- Other
- Built-up Area
- Estuarine/Water

# Ōhiwa catchment result

- profit surface for planted forests



($/ha)

- >3000
- 2000 - 3000
- 1500 - 2000
- 500 - 1500
- 0 -500
- -500 - 0
- -1500 - -500
- > -1500

Ohiwa Catchment

Kilometers
0 0.5 1    2    3    4

# Ōhiwa catchment result

- Value of avoided erosion surface



**($/ha)**

- > 1000
- 500 - 1000
- 250 - 500
- 200 - 250
- 150 - 200
- 100 - 150
- 50 - 100
- 0 - 50
- Ohiwa Catchment
- Native Forest
- Exotic Forest

Kilometers
0 0.5 1   2   3   4

# Private & public benefits from planted forests
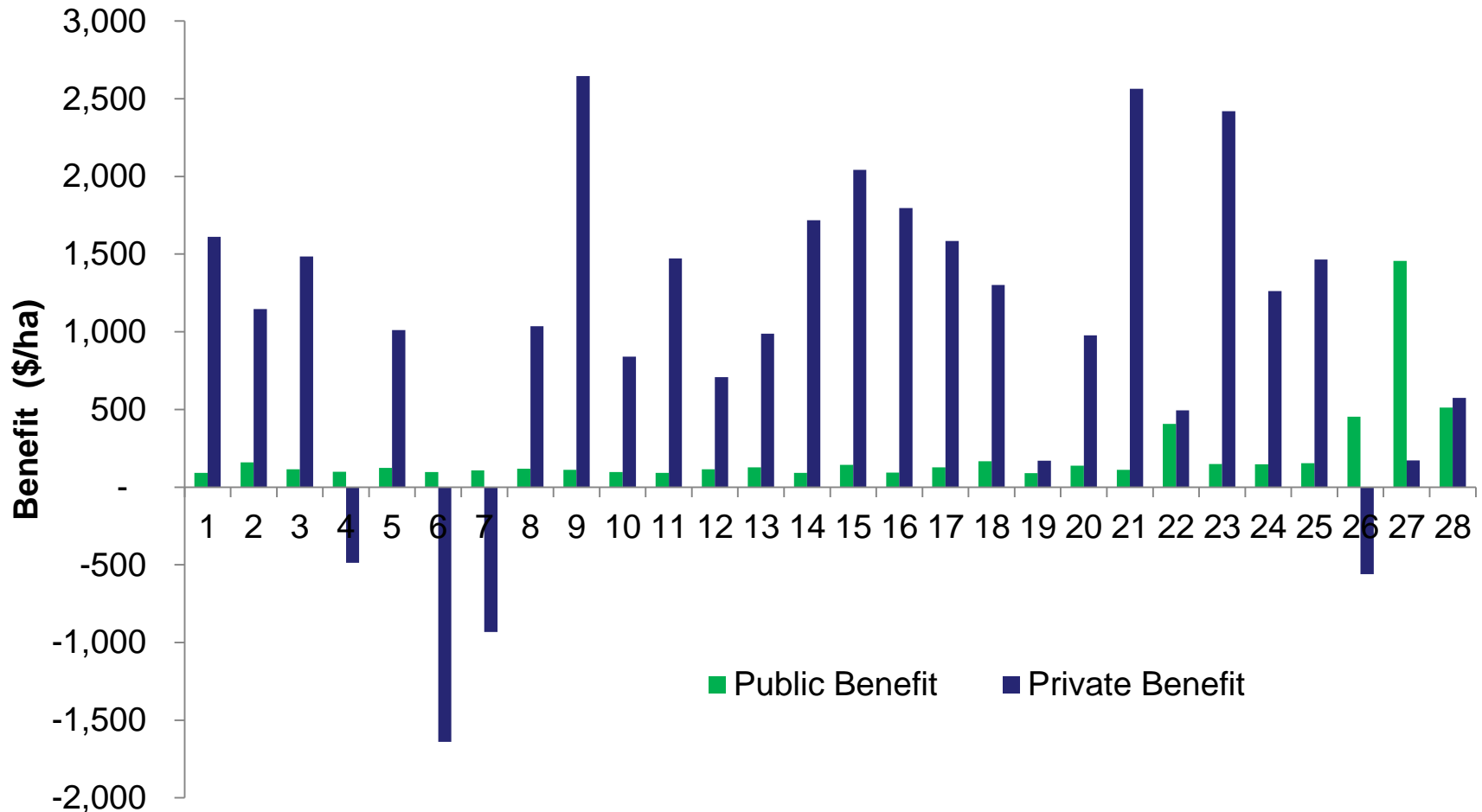
# Benefits of case studies

- Non-market values realised by society but invisible in policy
  - Case studies would provide indicative values to planners and policy makers
- Maintain competitiveness of forestry
  - Quantifying the benefits forests provide to economy, society and environment
  - Fair comparison with other land uses

"True value of planted forests"
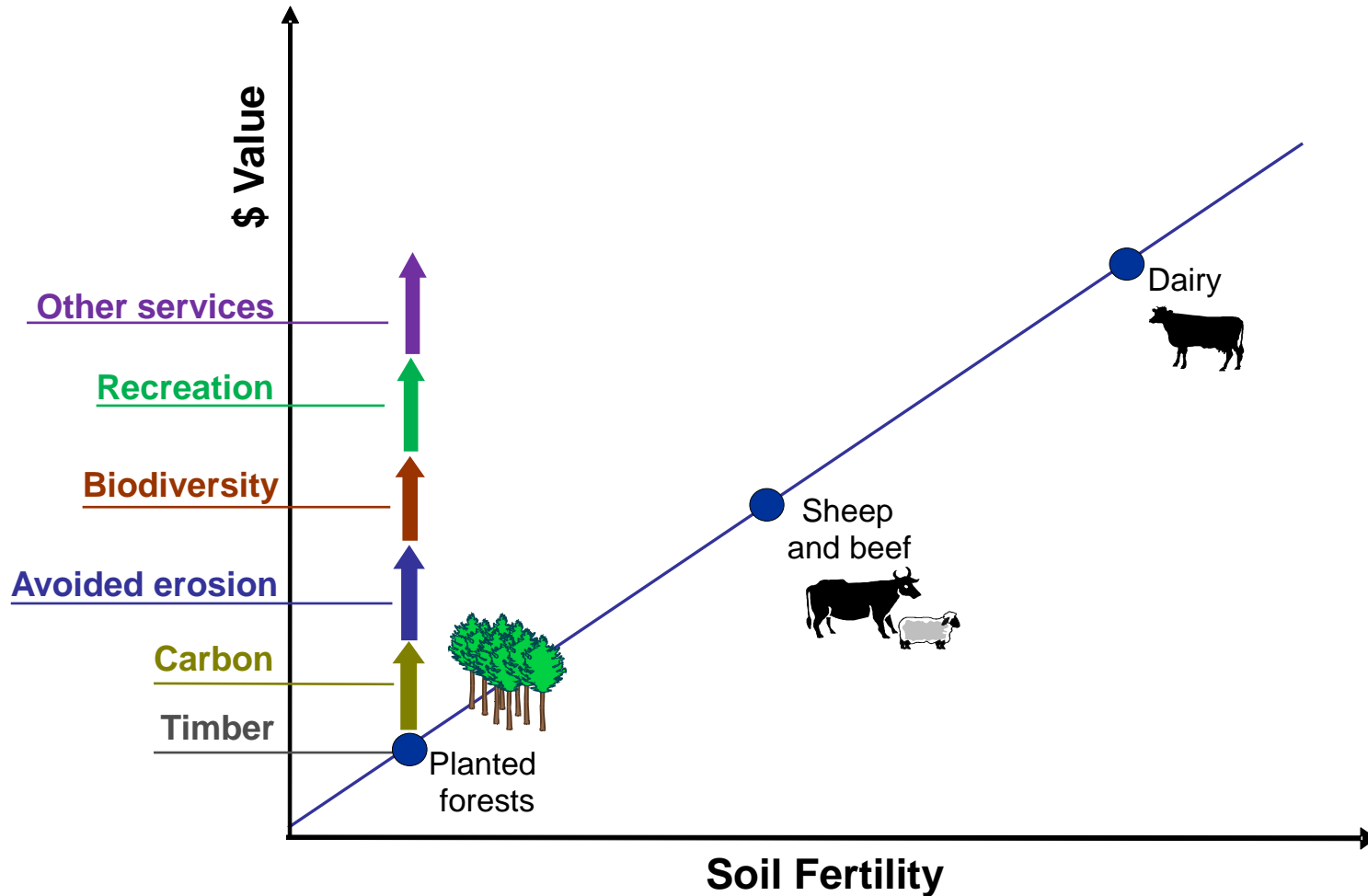
# Timeline

**Validation**
- Testing the validity of the viability estimates of the spatial economic framework
- 2014-2015

**Refinement**
- Evaluating and adding new ES value layers
- 2016-2017

**Links with other RAs**
- Economic, environmental and social impacts of interventions
- 2017-2018

**Outcomes**
- Contribute to land use decisions that incorporate the full value of key ecosystem services (timber, C, other ES)
- 2018-2019

# Thank you. Questions?