Working Party 6 Environmental Applications of Poplar and Willow
Gisborne New Zealand 10-12 March 2014

An Ecosystem Services Approach to the Evaluation of Soil Conservation in New Zealand hill country.

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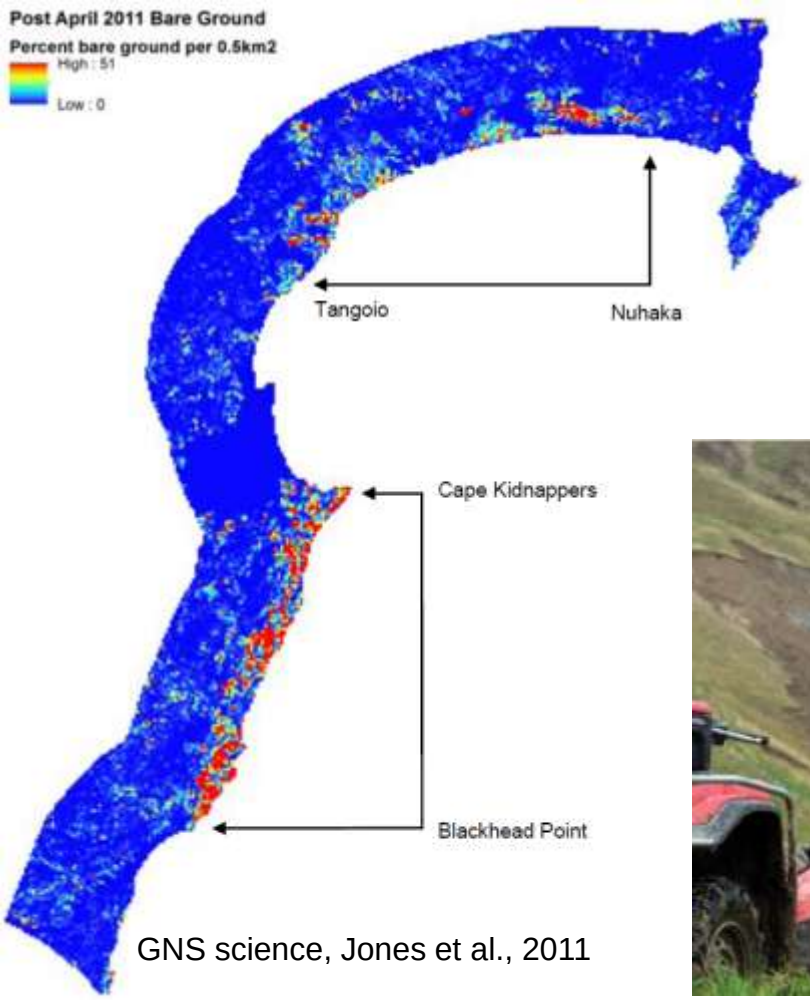
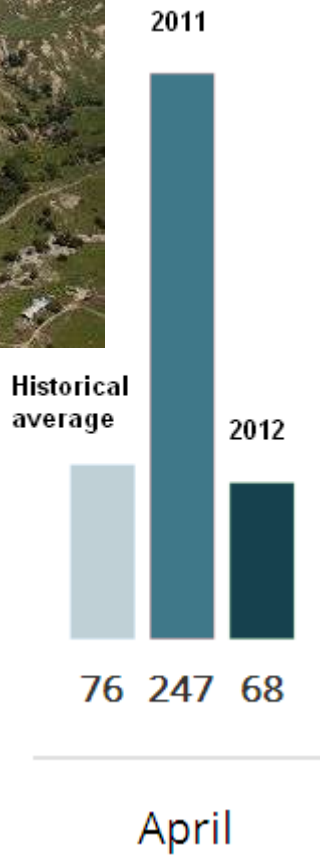
Soil erosion and conservation

Damage from April 2011 storm:

43 km^2 (4300 ha) of bare ground from a total area of 5900 km^2



GNS science, Jones et al., 2011



COST OF THE STORM

April 2011 Storm to Hawke's Bay Regional Council:

NZ$ 39 million = infrastructure, land, personal and commercial damage claims

Other costs?

- **Loss in pasture production**
- **Loss in natural capital stocks and ecosystem services?**

LOCALISATION OF DAMAGE

Land Use Capability class	1	2	3	4	5	6	7	8	other	Total
Area **in Sheep & Beef**	1,661	6,100	39,467	20,026	3,764	207,979	65,588	3,985	1,624	348,569
Area lost to erosion	4.7	24.4	109.7	54.3	25.5	2,156.7	1,341.3	503.8	2.9	4,220
Bare ground (% of total land in that LUC)	0.3%	0.4%	0.3%	0.3%	0.7%	1.0%	2.0%	**12.6%**	0.2%	NA
Bare ground (% of total area lost)	0.1%	0.6%	2.6%	1.3%	0.6%	**51.1%**	**31.8%**	**11.9%**	0.1%	100%

94.8%

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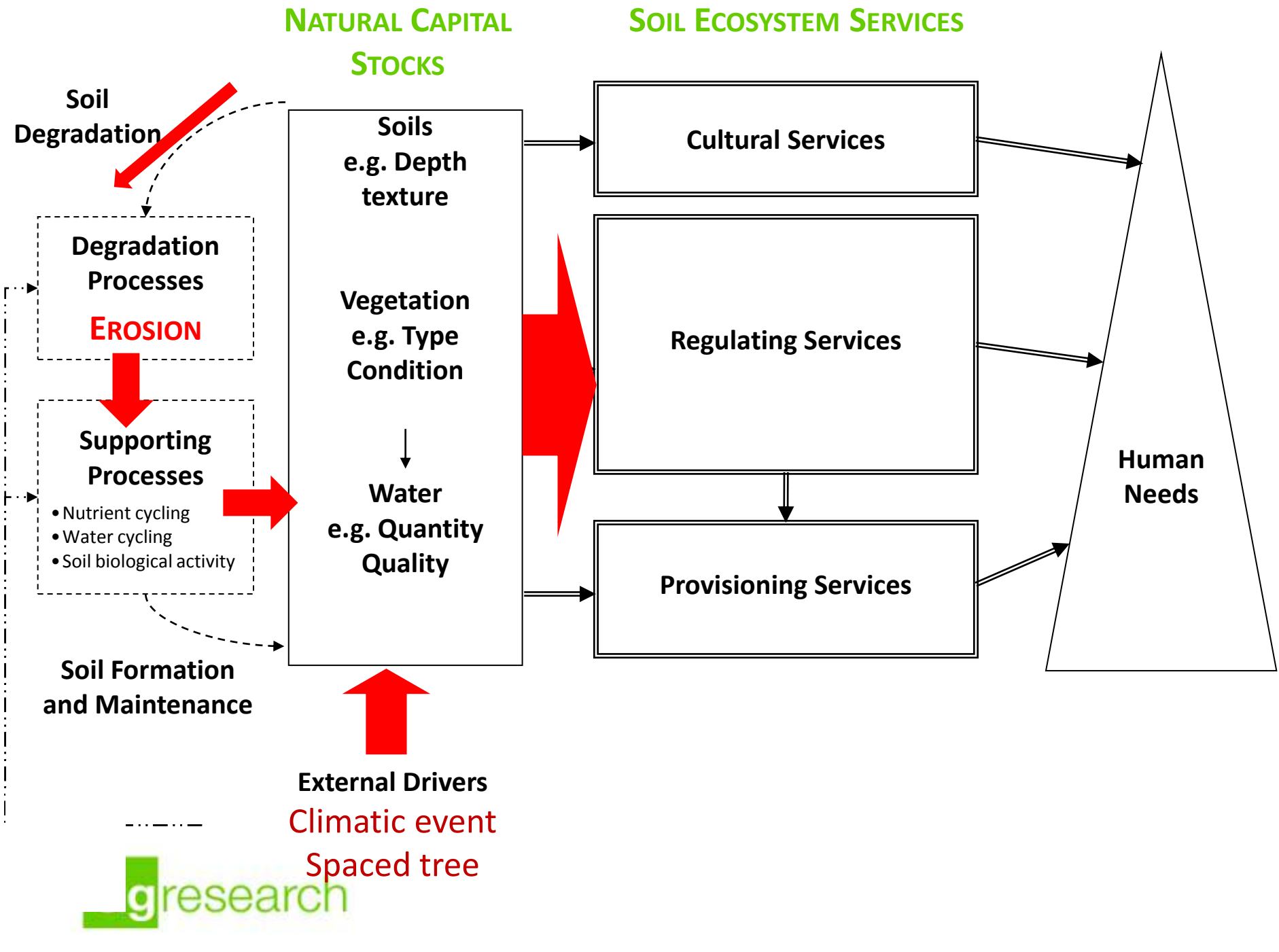
NATURAL CAPITAL STOCKS
SOIL ECOSYSTEM SERVICES
Soil Degradation
Degradation Processes
EROSION
Supporting Processes
• Nutrient cycling
• Water cycling
• Soil biological activity
Soil Formation and Maintenance
Soils e.g. Depth texture
Vegetation e.g. Type Condition
Water e.g. Quantity Quality
External Drivers
Climatic event
Spaced tree
Cultural Services
Regulating Services
Provisioning Services
Human Needs
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Soil conservation practices

“Ecological infrastructure investment”

Investment

Difficult to value beyond timber?

Ecosystem Services from spaced tree pasture systems

Provisioning Services:

- Provision of food (pasture quantity and quality)
- Provision of food: **Tree foliage**
- Provision of fibre: **Wood**
- Provision of physical support to human infrastructures and animals
- Provision of **shade and shelter** to farms animals from trees

Regulating Services:

- Filtering of nutrients (N and P) and contaminants
- Flood mitigation
- Recycling of wastes and detoxification
- Carbon storage in soil
- **Carbon storage in trees**
- Regulation of N_2O and CH_4 emissions
- Biological control of pests and diseases

Cultural Services:

- **Aesthetic experience**
- Recreation
- Cultural uses
- Spiritual enrichment (Earth sacredness)

FODDER FROM TREES

1 QUANTIFICATION:

- Estimate the amount of **foliage dry matter** depending on tree age and density (stems per hectare)

→ Kg DM/ha

2 VALUATION:

- Use the **market price** of pasture dry matter ($0.14/kgDM)

→ Value of fodder from trees (NZ$/ha/yr)

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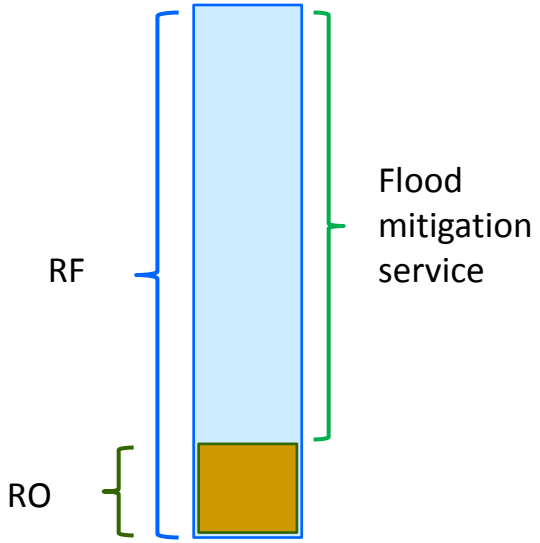
FLOOD MITIGATION

1 QUANTIFICATION:

- Quantify the service with OVERSEER : Rainfall (RF) - Runoff (RO)

→ Water stored by the soil (mm/ha/yr)



2 VALUATION:

- Use the **provision cost** method.
- Calculate the maximum amount **of water stored** by the soil for **7 consecutive days**
- Calculate the **size and annualised costs of dams** needed to stored that water on farm.

→ Value of flood mitigation (NZ$/ha/yr)

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Hawke's Bay
coastal zone
Low-producing grassland
High-producing grassland
Short-rotation cropland
Indigenous forest
Pine forest
Other exotic forest

Application ECOSYSTEM SERVICE FRAMEWORK
Erosion and soil conservation practices

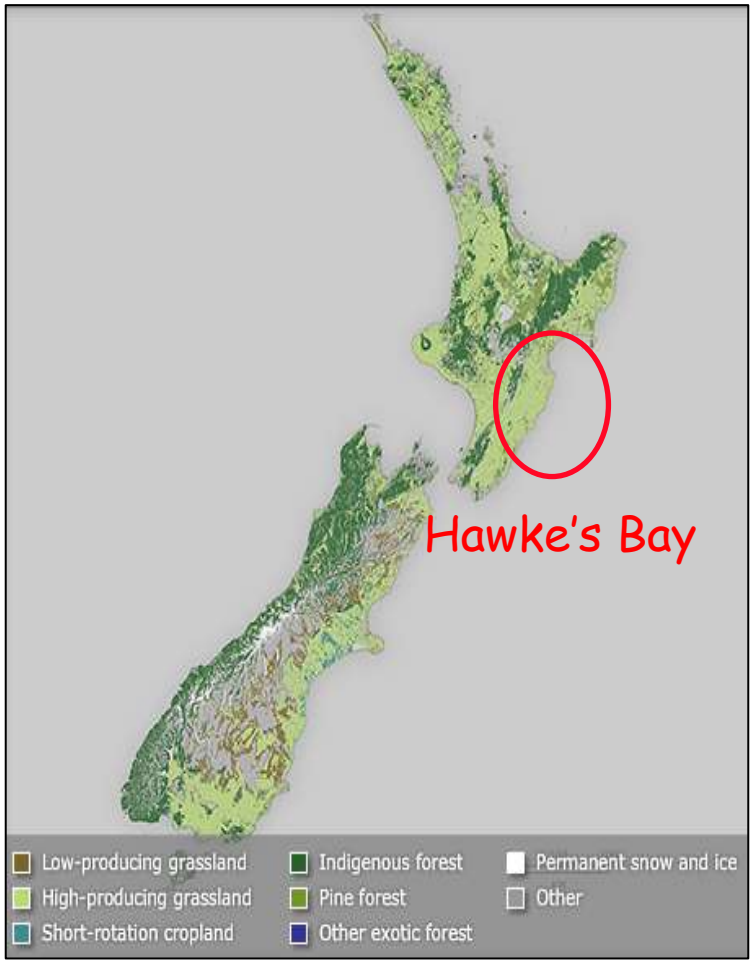
Hill country breeding and semi-finishing sheep and beef operation

Farm characteristics

- Area 570 ha
- Sheep to cattle ratio 70: 30
- Lambing 130%
- Stocking rate 10 su/ha
- Pasture grown 9 tDM/ha/yr

Climate

- Rainfall 1000 mm
- Summer dry .



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Value of Ecosystem Services from grazed pasture

Service	Value (NZ$/ha)
Food Quantity	484
Food Quality	29
Support for human infrastructures	0
Support for farm animals	33
Subtotal for provisioning services	**546**
Flood mitigation	911
Filtering of nutrients and contaminants	1800
Decomposition of wastes	127
Net Carbon accumulation (0-10cm)	2
N_2O regulation	1
CH_4 oxidation	0.08
Regulation of pest and disease populations	328
Subtotal for regulating services	**3171**
Total value ($/ha/yr)	**3717**

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COMMENT

Services with the highest value were

- filtering of nutrients and contaminants (46%)
- flood mitigation (24%)
- provision of food (14%).

Not withstanding the *numerous limitations* of the approach and analysis the findings are revealing

Currently the "value" of grassland systems is largely limited to the contribution land makes to food supply.

- Little recognition is given to the regulating services provided by our grassland systems.
  - Both to the land owner and community

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Hawke's Bay in April 2011

- Heavy rain storm event along a 250km coastal strip
- Provoked significant landslides on hill slopes.

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Loss of natural capital stocks

Loss of services after an erosion event

Service	Immediately following the erosion event
Food Quantity	0%
Food -Quality	0%
Support human infrastructures	Nil
Support for farm animals	0%
Flood mitigation	30%
Filtering of nutrients and contaminants	30%
Decomposition of wastes	5%
Net Carbon accumulation	0%
Nitrous oxide regulation	0%
Methane oxidation	0%
Regulation of pest and disease	155%

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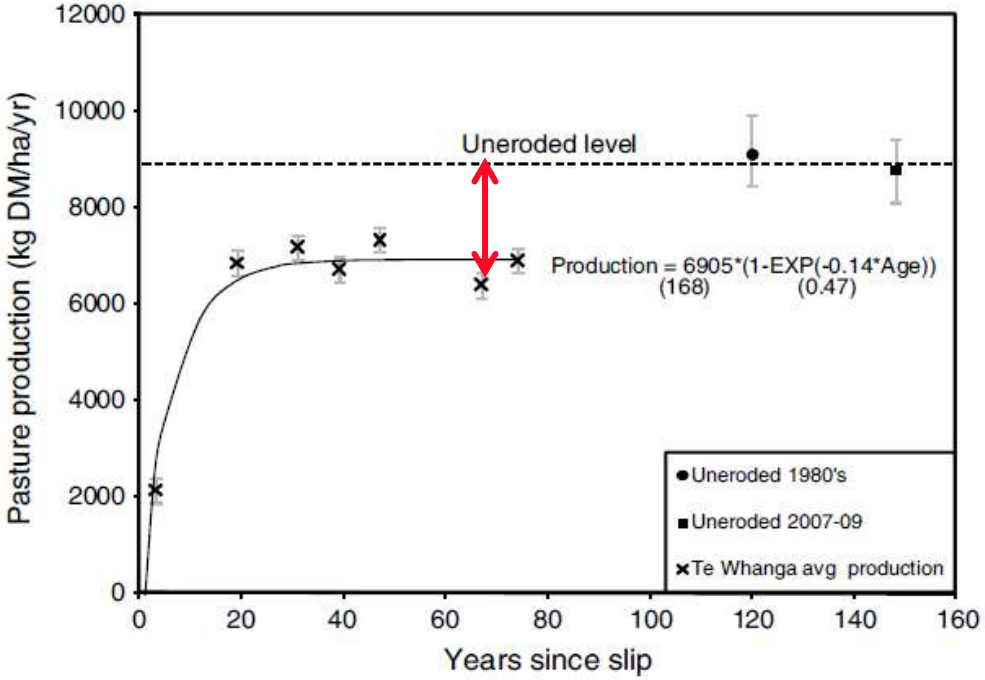
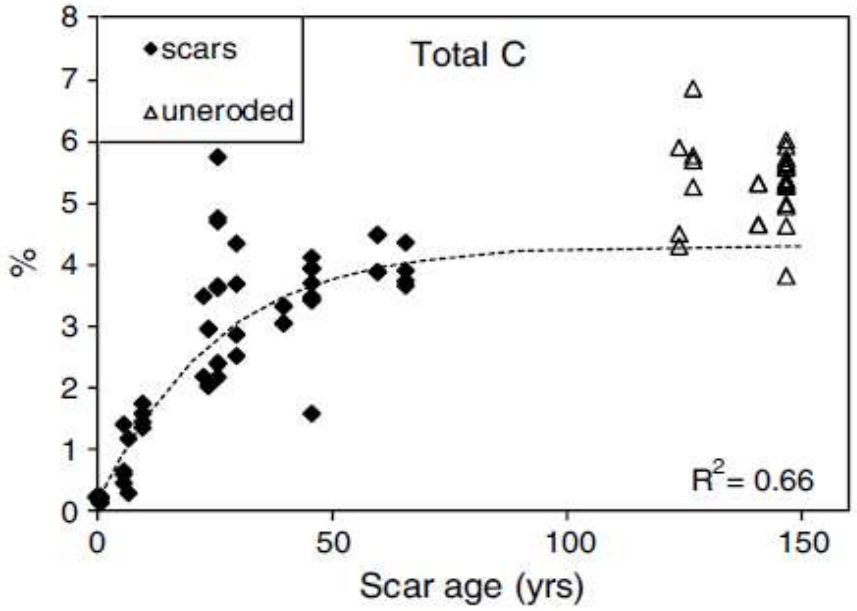
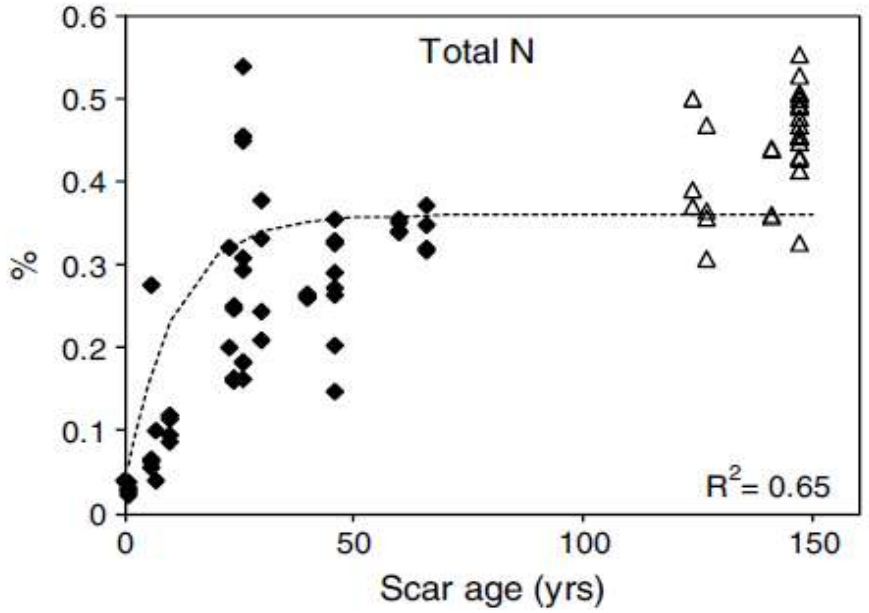
RECOVERY OF SOIL PROPERTIES



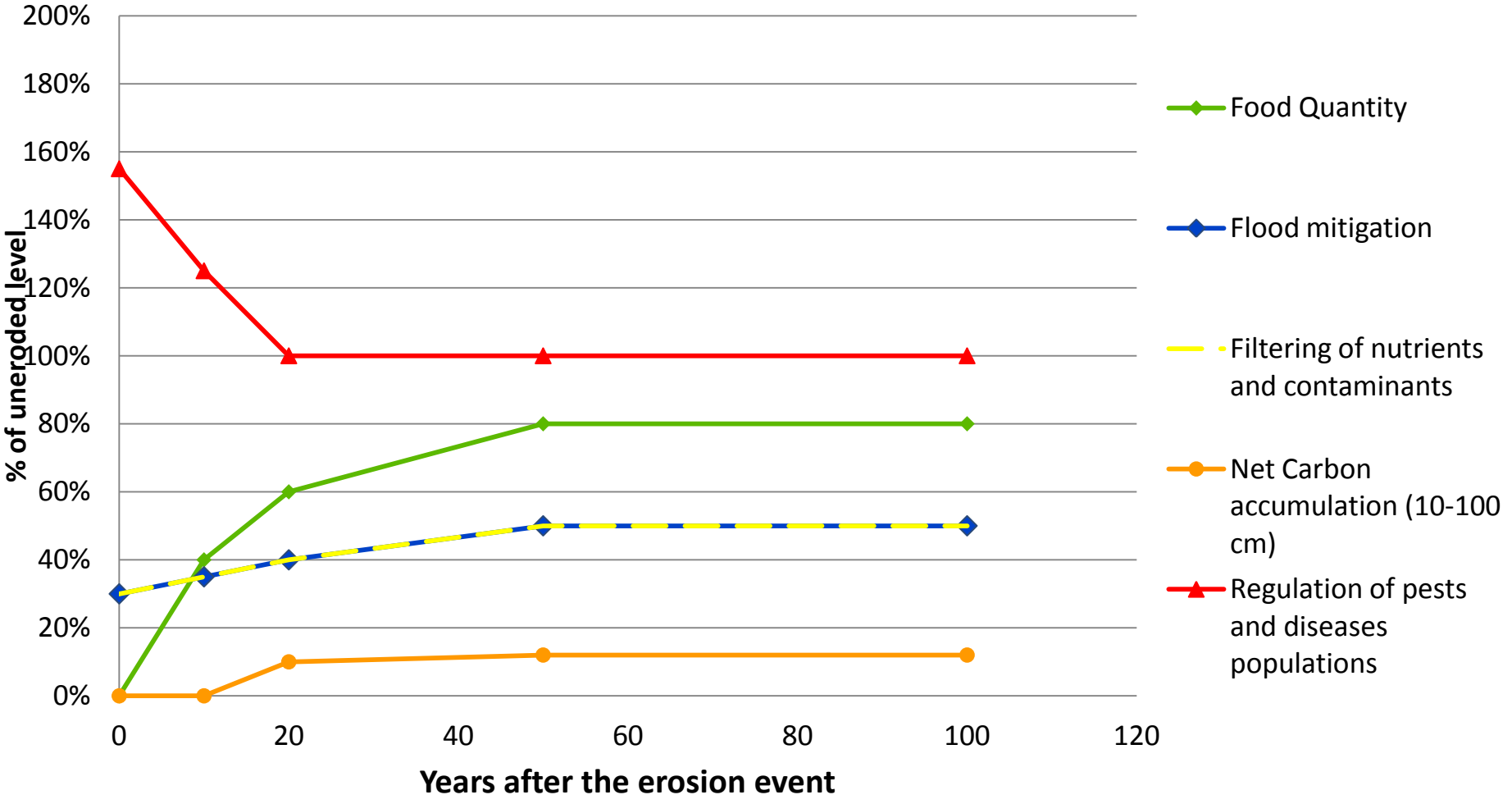
Pasture production semi-permanently reduced by 20%





Rosser B.J., Ross C.W. (2011) Recovery of pasture production and soil properties on soil slip scars in erodible siltstone hill country, Wairarapa, New Zealand. New Zealand Journal of Agricultural Research 54:23-44.

TRENDS OF RECOVERY OF ES AFTER EROSION – NO TREES



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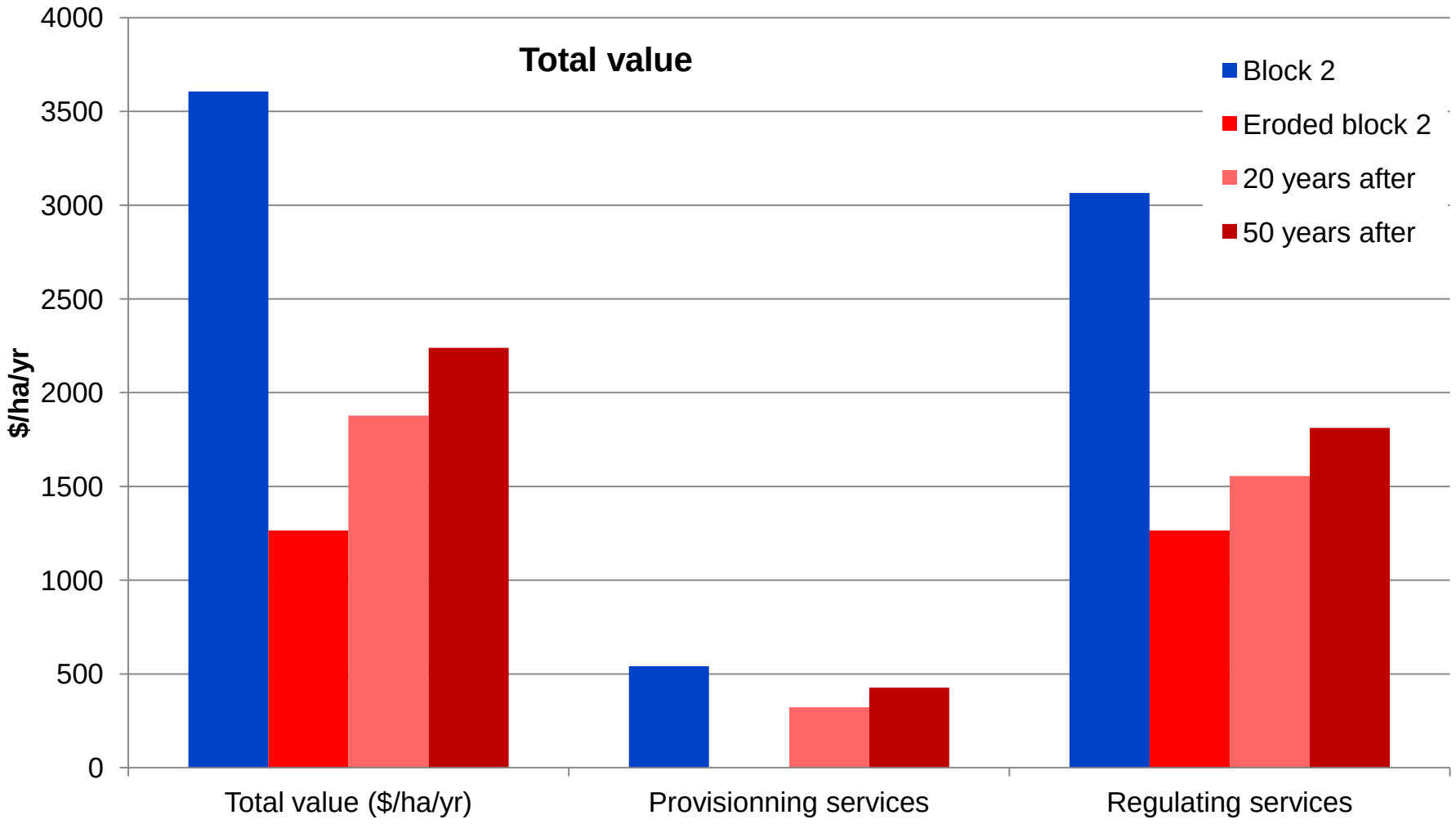
Value of ES before and after erosion



→Value of the flows of Ecosystem services **NOT** the Natural Capital stocks

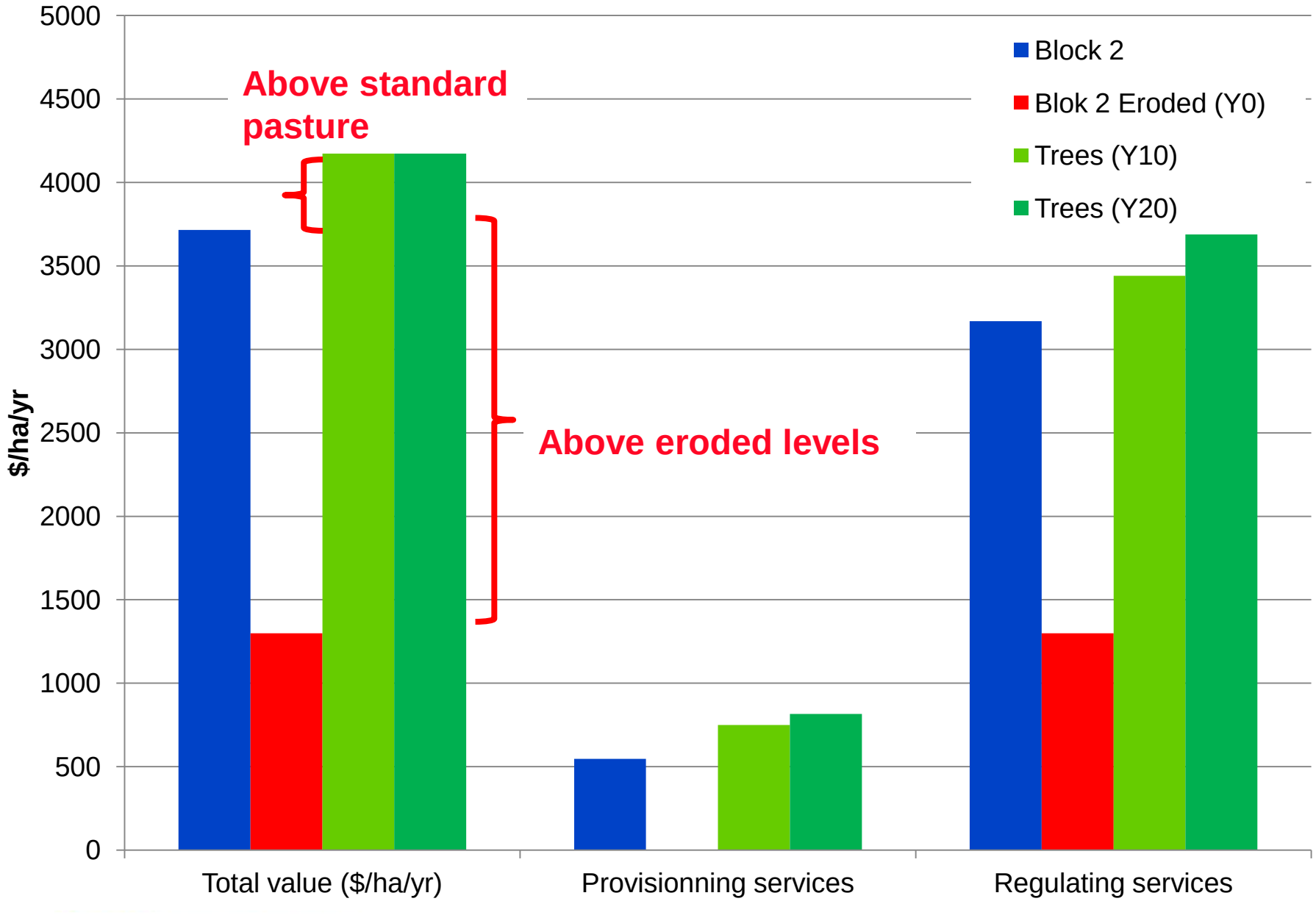
→Value of **regulating services** is **greater** than value of the **provisioning services**

→ **Recovery non linear**: rapid between years 1-20, then slows down

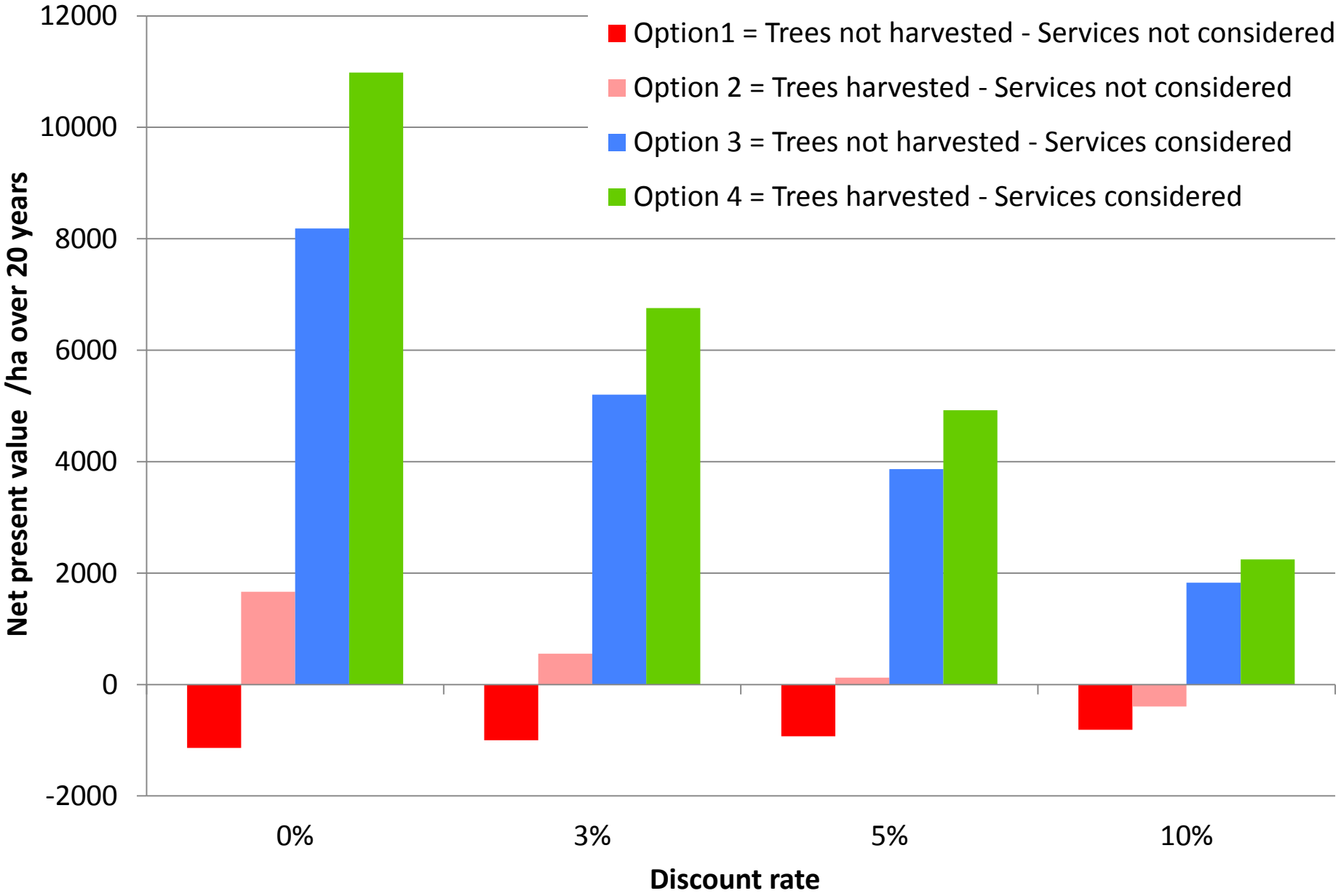
ECOLOGICAL INFRASTRUCTURE

Service	Pasture	Eroded 20 yr	With trees
Food Quantity Pasture	484	290	363
Food Quantity Tree	**NA**		**210**
Food Quality-Pasture	29	17	29
Wood- Fibre	**NA**		**104**
Provision of support human infra.	0	0	0
Provision of support for farm animals	33	17	33
Provision of shade	NA		58
Provision of shelter	NA		19
Flood mitigation	911	364	990
Filtering of nutrients and contaminants	1800	807	1960
Decomposition of wastes	127	76	170
Net carbon accumulation (soil)	2.2	22	1.3
Net carbon accumulation (tree)	NA		300
Nitrous oxide regulation	1.2	0.6	2.7
Methane oxidation	0.08	0.04	0.16
Regulation of pests and diseases populations	328	328	327
Total value ($/ha/yr)	3717	1922	4568

VALUE OF ES – WITH AND WITHOUT TREES



BCA of 4 management options and 4 discount rates



SUMMARY

Value of the flows of ecosystem services **NOT** the Natural Capital stocks

Does offer a method for tracking the state of our natural resources through the flow of services

Provides an approach for "valuing " ecological infrastructure investments

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FINAL WORD

Increasing interest in the use of an ecosystem servcie approach to resource management

Ecosystem service quantification and valuation as a science is in its infancy

Uptake and use of the approach will be limited until

- there is further development
- demonstrated utility and value

Not withstanding the current limitations of the approach it provides *insights into land use* beyond the provision of food.

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ACKNOWLEDGEMENT

Funding for this study was provided by

- Envirolink tools programs through Hawke's Bay Regional Council
- Rutherford foundation of the Royal Society of New Zealand
- Sustainable Land Use Research Initiative.

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