Ruamahanga Economic Catchment Model

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LANDCARE RESEARCH
MANAAKI WHENUA

The aim of tonight…

NZFARM
NEW ZEALAND FOREST AND AGRICULTURE REGIONAL MODEL

- Remind you of:
  - What NZFARM can report against
  - What NZFARM modelling can be used for
- Clarify level of specificity needed to model the policy packages
- Get feedback on what is best way to report results back to RWC

Reminder: what it is?

NZFARM
NEW ZEALAND FOREST AND AGRICULTURE REGIONAL MODEL

- A catchment-level economic model of NZ land use
  - Objective is to maximize income from land-based activities
  - Spatial scale at sub-catchment level
  - Models changes in land use and land management
  - Key outputs include changes in farm income, land use/mgmt
  - Can assess trade-off of multiple contaminants and policy approaches
- Designed to consistently compare **the relative economic & environmental impacts** of a range of policy scenarios

Key Model Outputs

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$$$ **Net Revenue** (from on-farm production)

Food (meat, milk, fruit, etc.)

Raw materials (timber, pulp, wool, silage, etc.)

Freshwater (N, P, *E.coli*, irrigated area)

Erosion and Prevention (soil loss/retain by land use)

Carbon Sequestration (exotic and native forest, grassland, etc.)

Outputs will vary subject to:

- Contaminant load target(s)
- Policy mechanism
- Mitigation cost & effectiveness

How can NZFARM be used to help you…..

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- Economic impacts of Scenarios
  - BAU, gold, silver, bronze
  - Based on RWC determining what would happen (akin to ‘painting’ the new landscape)
- Compare policy packages
  - Based on policy levers/approaches/packages RWC would like to use to achieve the preferred scenario

Attributes we can report on...

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Attribute	Can we report
Farm income (EBIT)	Yes
EBIT/m3 water used	Yes
Number of days of irrigation restriction	# days comes from other modelling; can estimate the output difference between with and without restrictions
Water storage	Yes, similar to above; can estimate the output difference between with and without extra water
Environmental impacts of policy options	Yes – N, P, sediment, *E.coli* & GHG
Cash farm surplus	No, input data only contains EBIT (not debt information)
Farm return on capital	No, input data only contains EBIT (no debt information)
Number of jobs	No, not directly. Could estimate using other info sources
Farm expenditure	No, coming from other modelling

Policy package details

- For each management option need to know how RWC want so achieve that (i.e., what policy levers want to compare)
- Remember….we can't model everything
- e.g. retiring land on steep slopes
  - Require specific types of land (e.g. land with slope > 25^{o})or specific areas of land are retired
  - Payments to incentivise land retirement
    - Rates rebate on retired land that meet certain requirements (need to know rebate details)
    - Direct payments to compensate lost revenue (need to know if partial or full compensation)

Policy package details

- e.g. riparian planting
  - Require specific riparian areas to be replanted (need to know what areas are planted)
  - Payments to incentivise riparian planting
    - Rates rebate for riparian areas that are replanted (need to know rebate details)
    - Direct payments to compensate lost revenue (need to know what compensating)
    - Contributions to riparian planting cost (need to know contribution amt/portion)
  - Technical support (can't be directly modelled)

- e.g. on-farm mitigation
  - Require specific mitigation bundles to be implemented (need to know who is to do what)
  - Payments to incentivise on-farm mitigation options
    - Direct payments to cover costs (need to know what costs are being covered)
    - Cost-share (need to know level of cost-share for each tier)
  - Technical support (can't be directly modelled)

Different ways to present information

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For the policy packages:

- impact on farm income, environmental indicators
  - Tables and/or maps
- Impact on farm income by land use
  - Bar chart
- Change in land use
  - Bar chart
- Uptake of mitigation practices
  - Bar chart
- Annual costs by mitigation practices
  - Bar chart

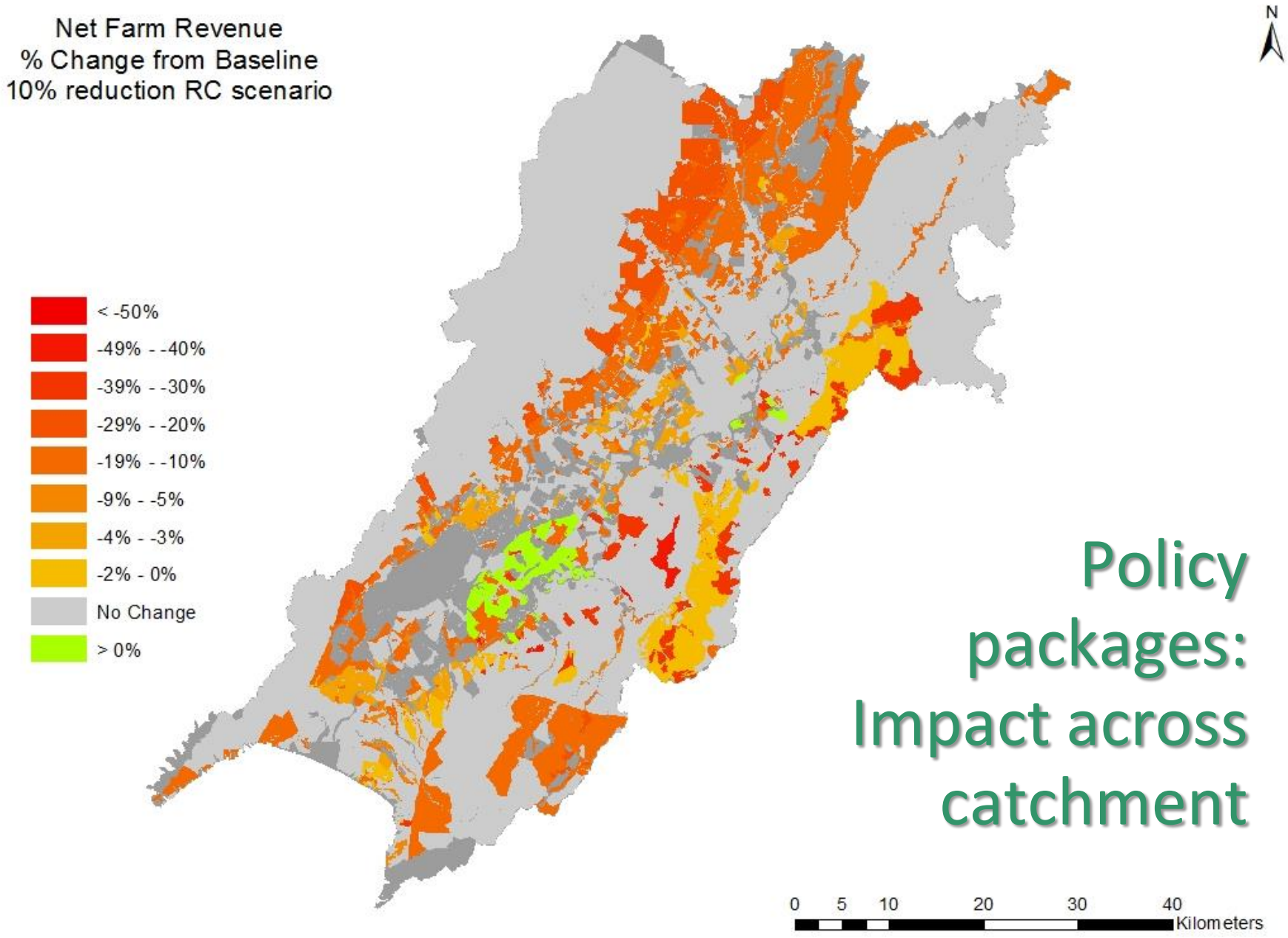
Policy packages: Catchment level impacts

Tables

Example Policy Package	Total Annual Cost ($/yr)	Net Revenue ($)	N Leach (t)	P Loss (t)	Sediment (kt)	E.coli (peta)
Baseline	$0	$200,679,150	5,285	209	814	134.7
% Change from no mitigation baseline						
All Farms M1	$583,436	0%	0%	0%	0%	-4%
All Farms M2	$18,270,930	-9%	-10%	-7%	-9%	-4%
All Farms M3	$27,926,712	-14%	-10%	-48%	-25%	-4%
Convert All to Forest	$108,954,857	-54%	-82%	-82%	-41%	-84%
10% catchment	$12,193,487	-6%	-10%	-15%	-10%	-3.7%
10% FMU	$15,713,580	-8%	-10%	-28%	-10%	-3.0%

Maps of each policy package

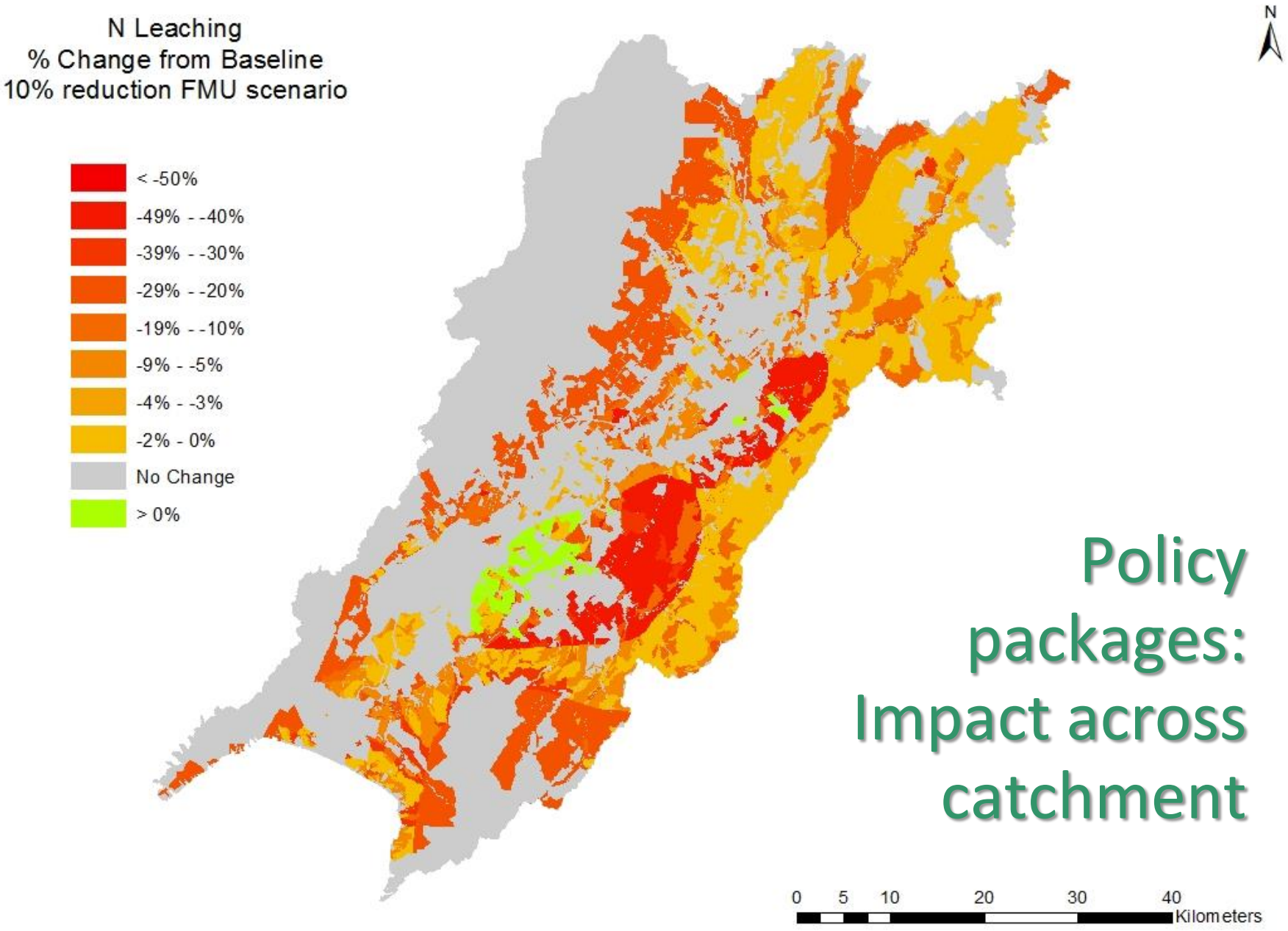
Net Farm Revenue



Policy packages: Impact across catchment

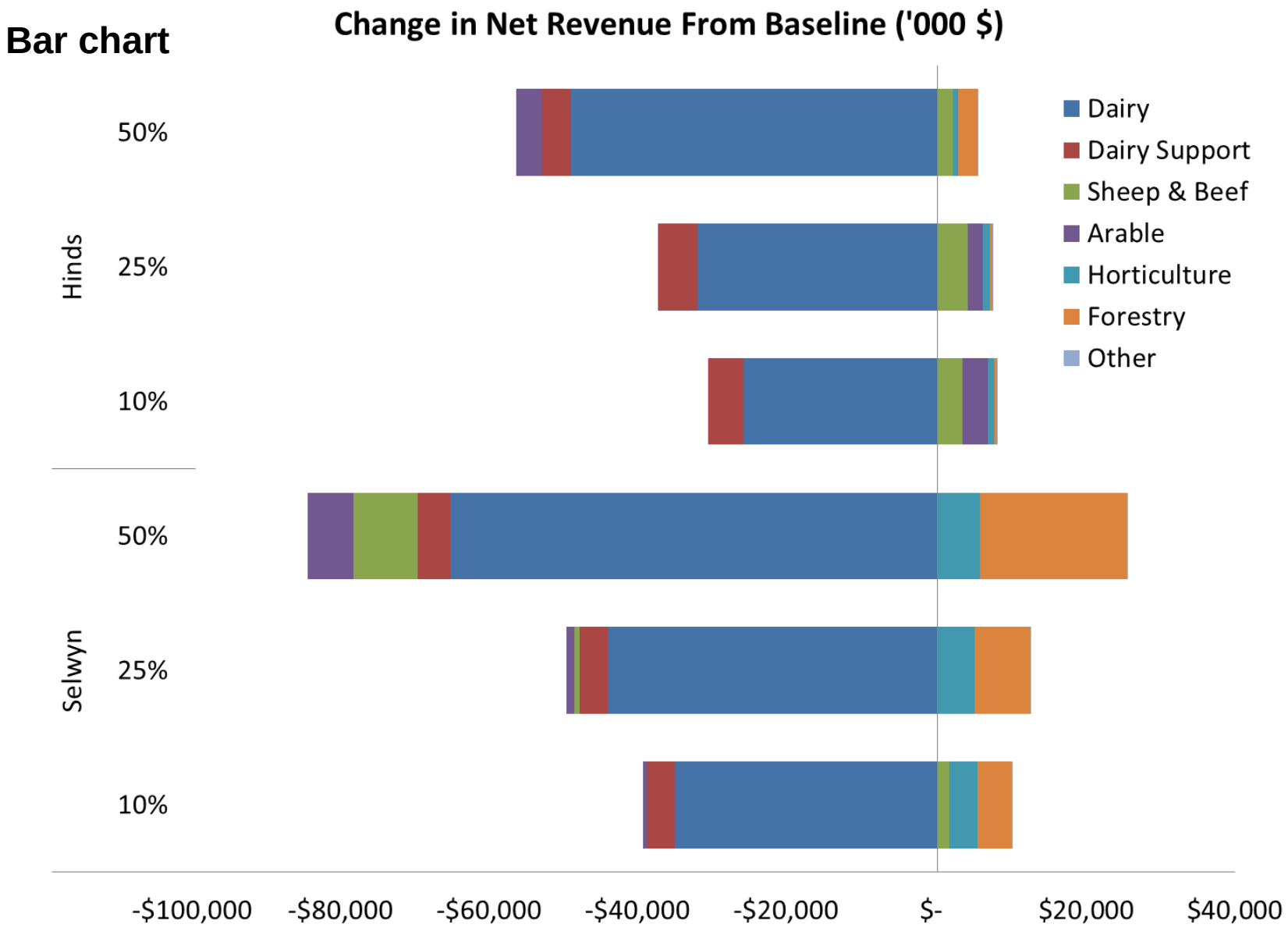
Maps of each policy package

Net Farm Revenue

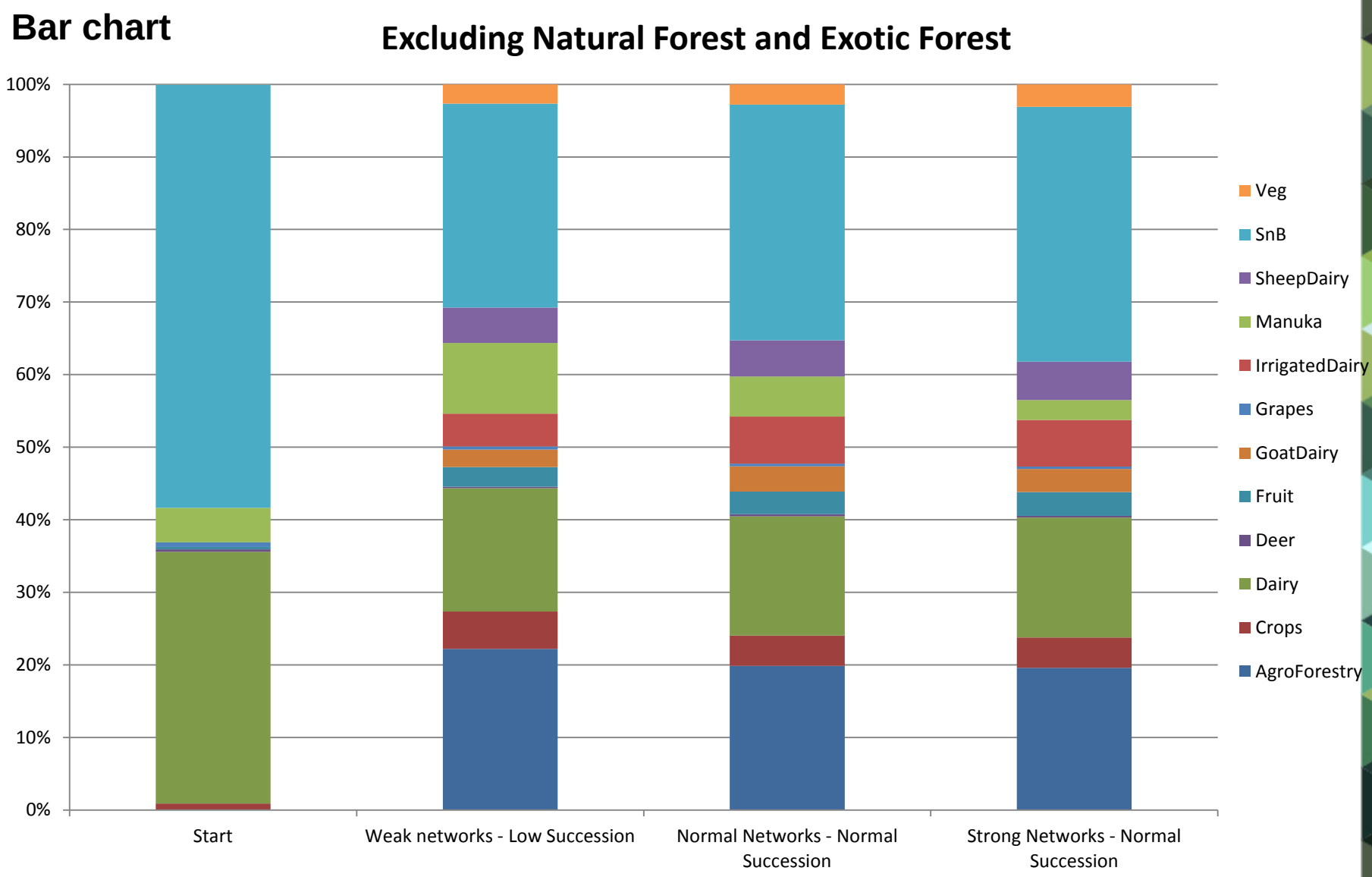


Policy packages: Impact across catchment

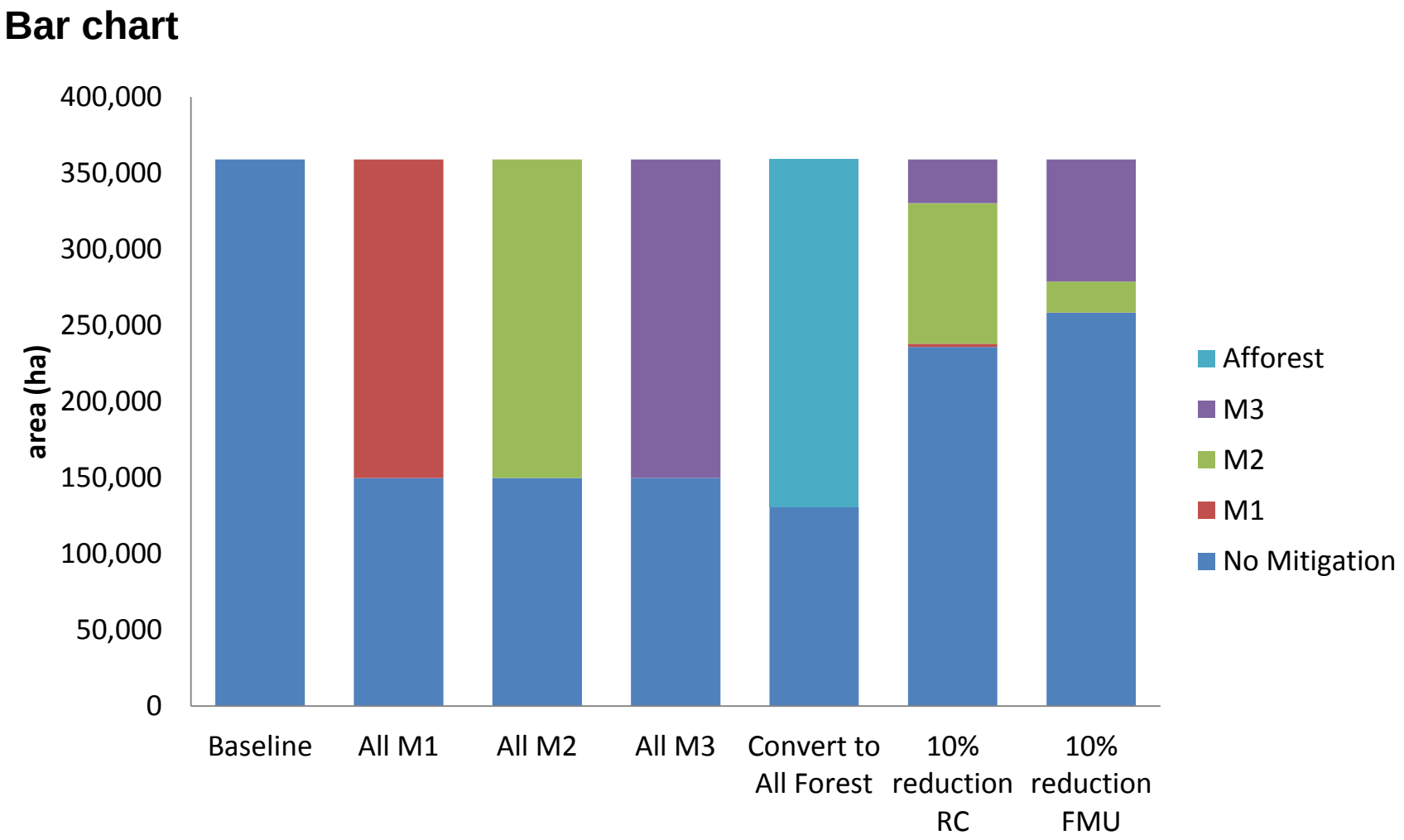
Policy packages: Income impacts by land use



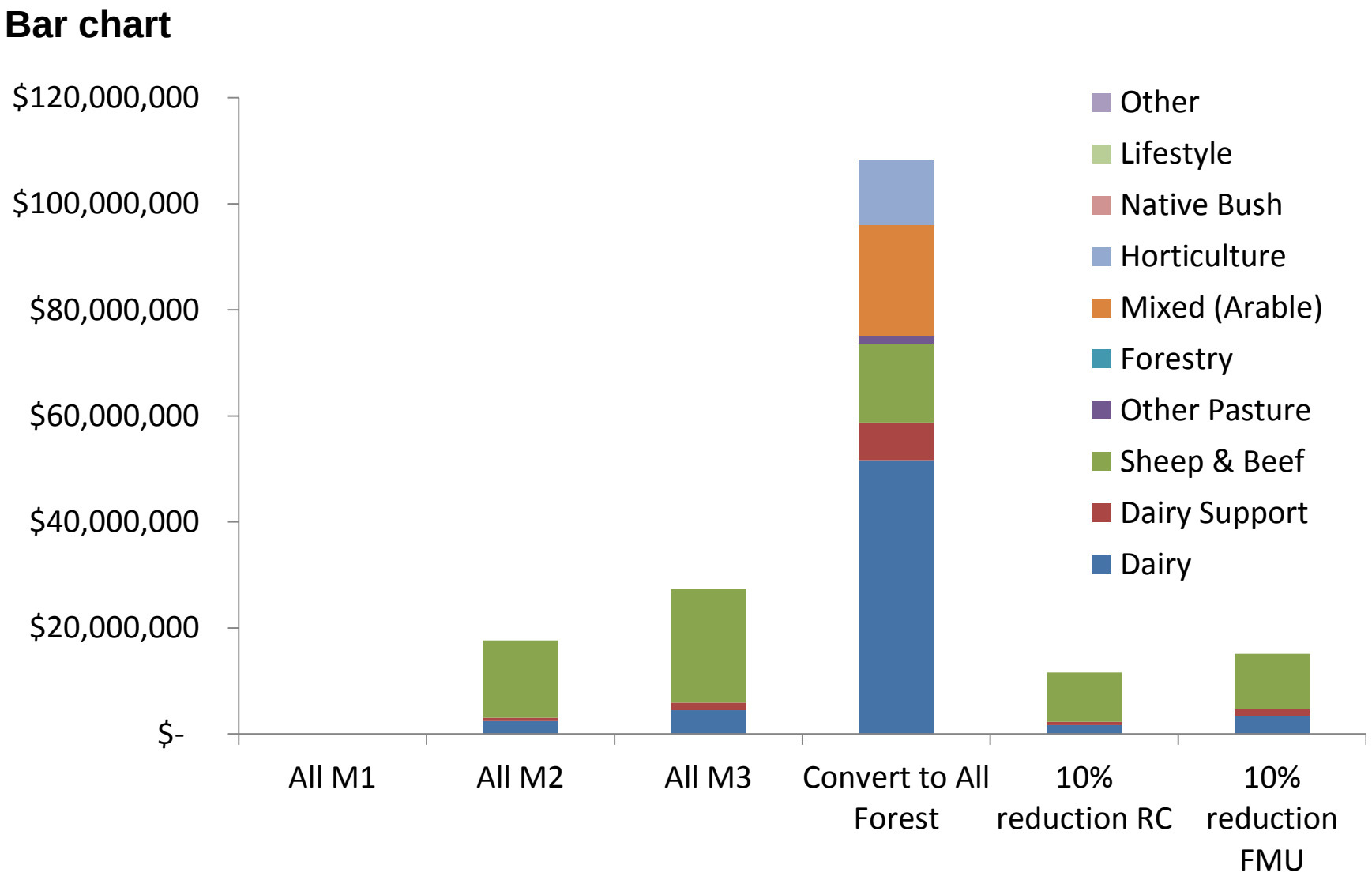
Policy packages: Land use change



Policy packages: Uptake of mitigation bundles



Policy packages: Annual costs by land use



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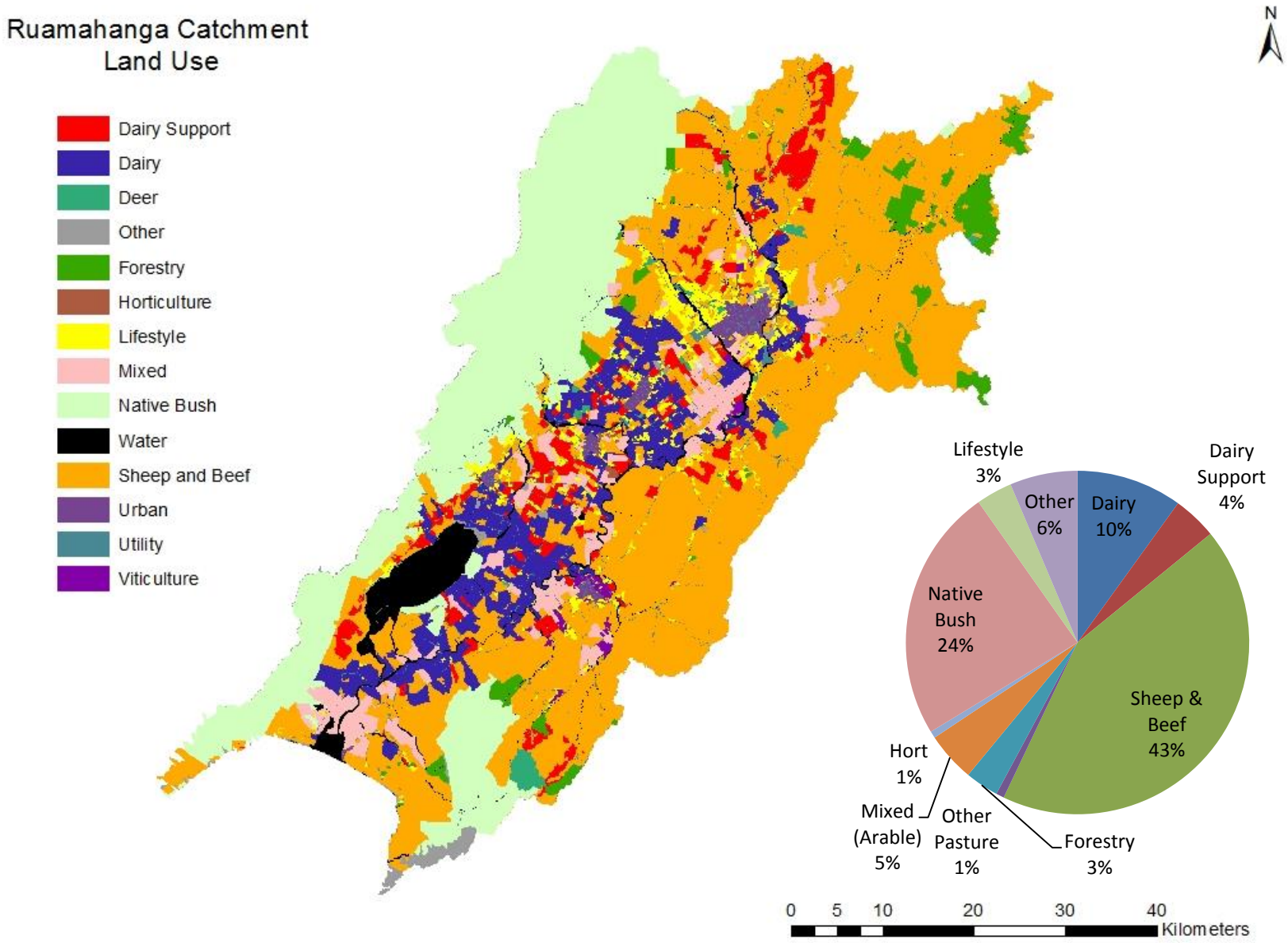
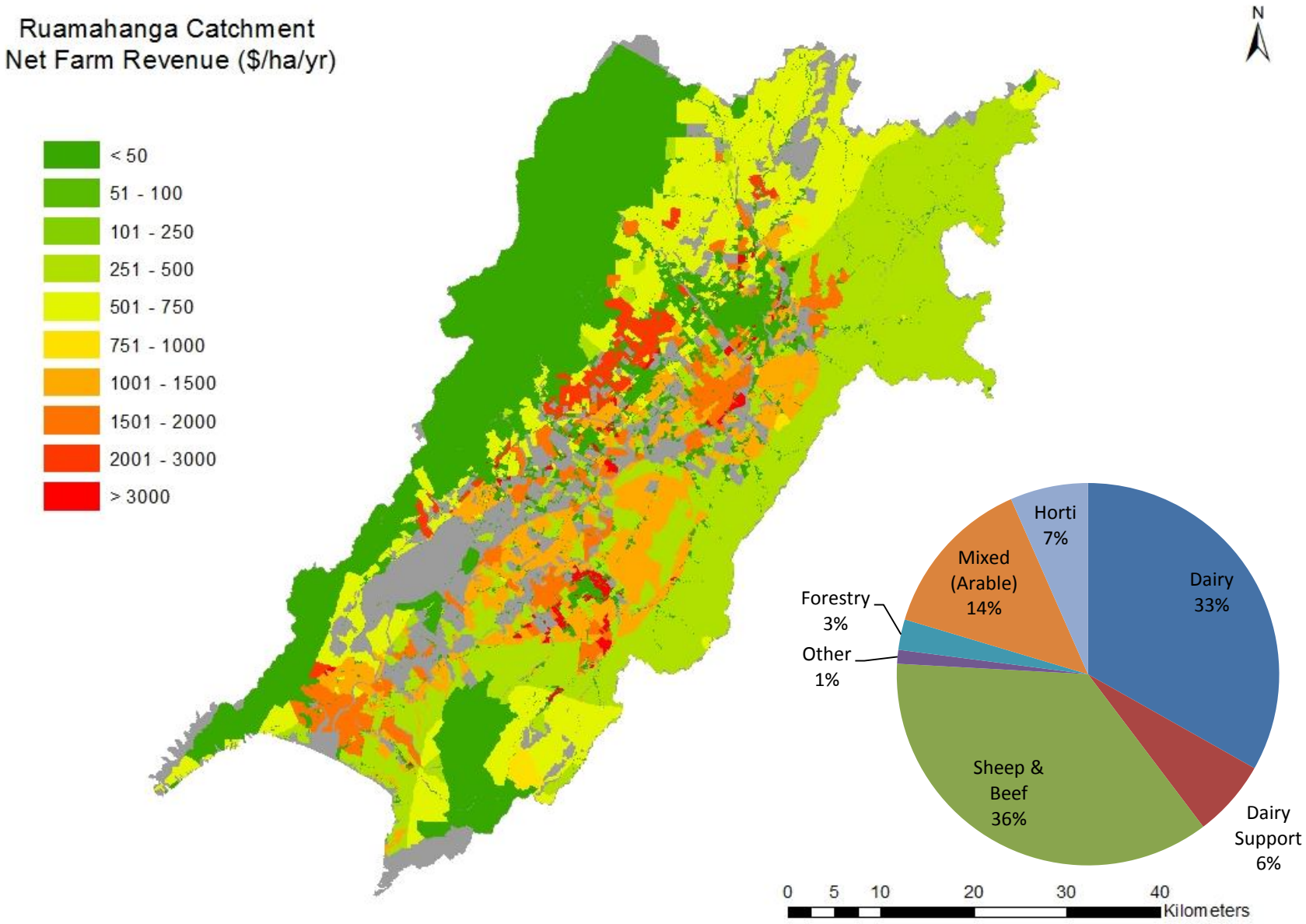
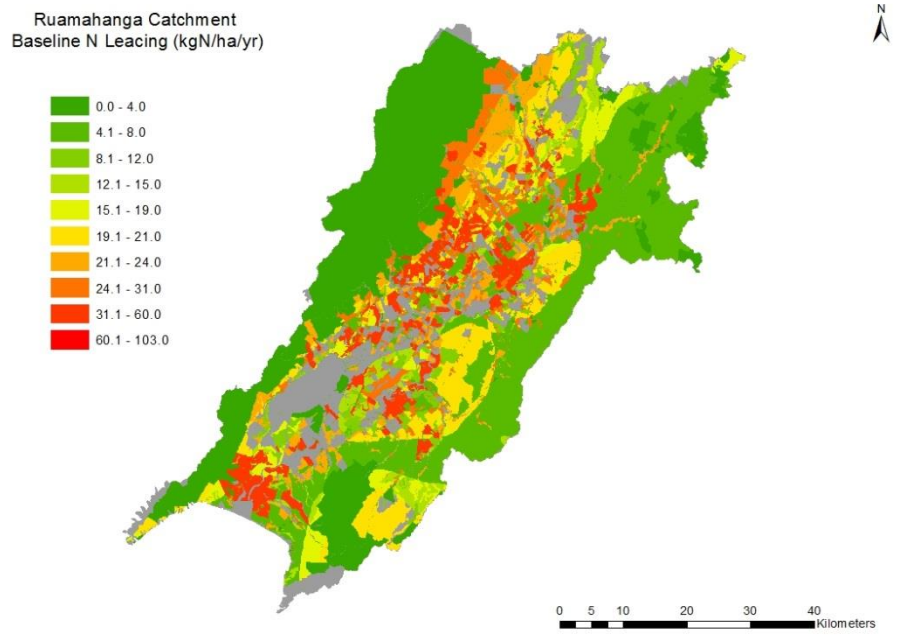
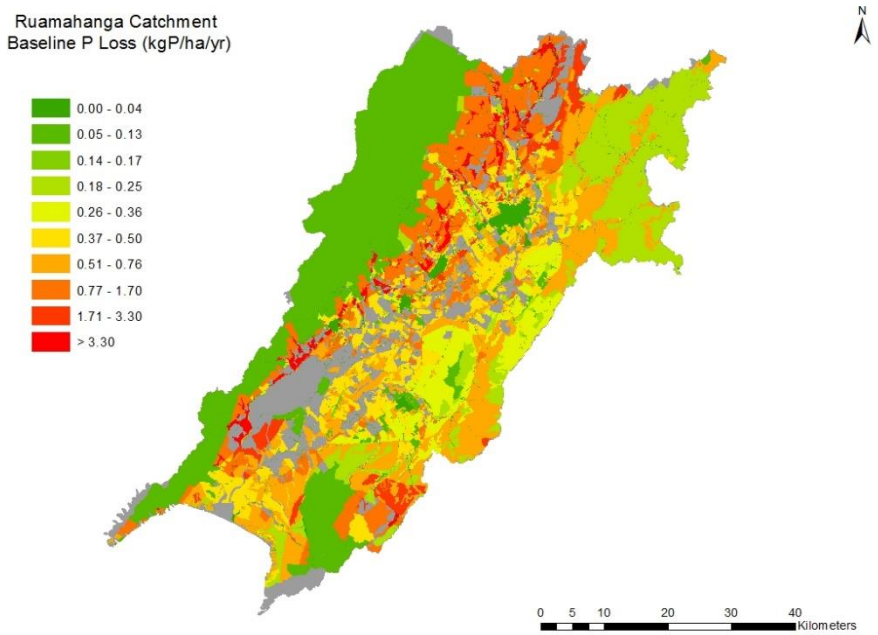
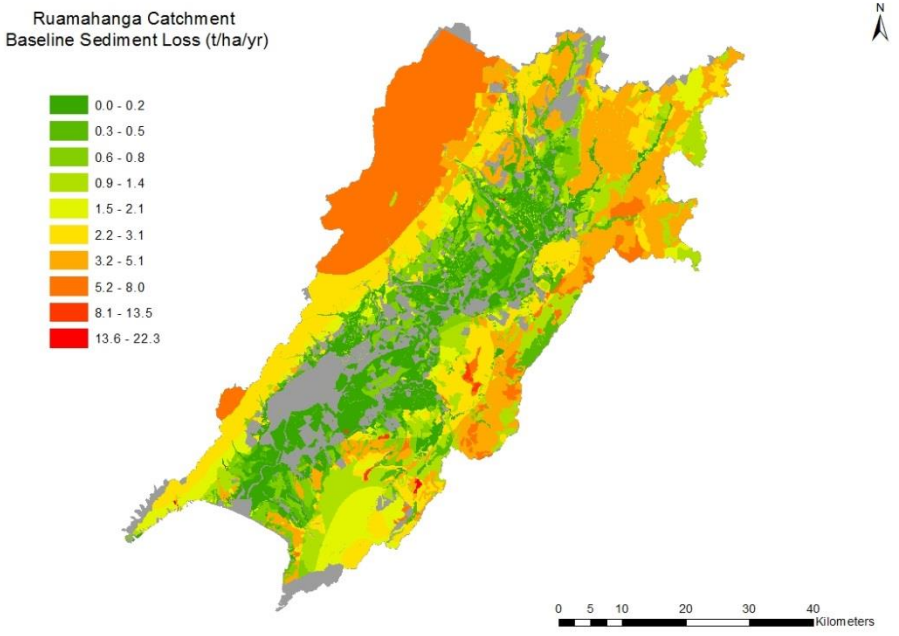
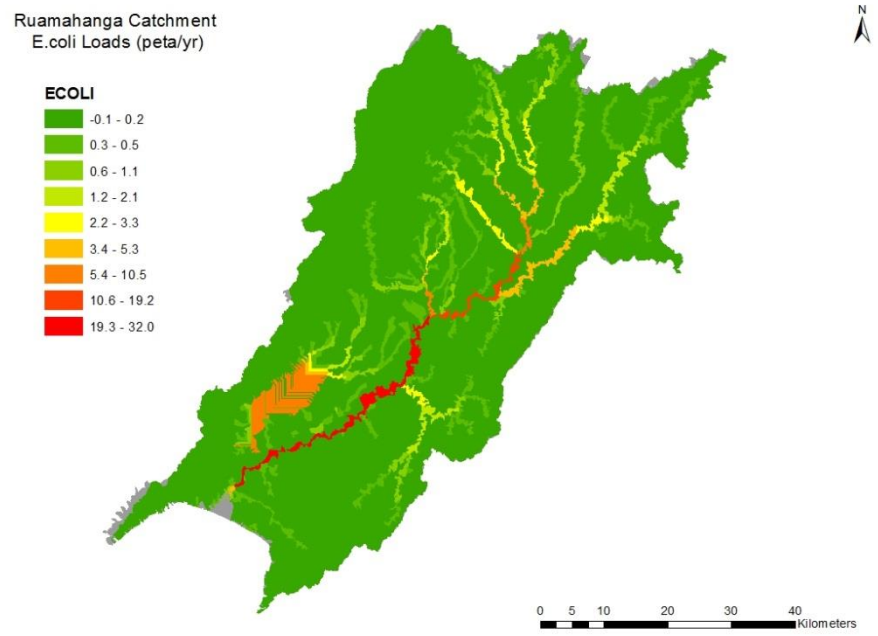

Ruamahanga Catchment
Land Use
Dairy Support
Dairy
Deer
Other
Forestry
Horticulture
Lifestyle
Mixed
Native Bush
Water
Sheep and Beef
Urban
Utility
Viticulture
N
Lifestyle 3%
Dairy Support 4%
Other 6%
Dairy 10%
Native Bush 24%
Sheep & Beef 43%
Hort 1%
Mixed (Arable) 5%
Other Pasture 1%
Forestry 3%
0 5 10 20 30 40
Kilometers


Ruamahanga Catchment
Net Farm Revenue ($/ha/yr)
< 50
51 - 100
101 - 250
251 - 500
501 - 750
751 - 1000
1001 - 1500
1501 - 2000
2001 - 3000
> 3000
N
Horti 7%
Mixed (Arable) 14%
Dairy 33%
Forestry 3%
Other 1%
Sheep & Beef 36%
Dairy Support 6%
0 5 10 20 30 40
Kilometers


Ruamahanga Catchment
Baseline N Leacing (kgN/ha/yr)
0.0 - 4.0
4.1 - 8.0
8.1 - 12.0
12.1 - 15.0
15.1 - 19.0
19.1 - 21.0
21.1 - 24.0
24.1 - 31.0
31.1 - 60.0
60.1 - 103.0
N
0 5 10 20 30 40
Kilometers


Ruamahanga Catchment
Baseline P Loss (kgP/ha/yr)
0.00 - 0.04
0.05 - 0.13
0.14 - 0.17
0.18 - 0.25
0.26 - 0.36
0.37 - 0.50
0.51 - 0.76
0.77 - 1.70
1.71 - 3.30
> 3.30
N
0 5 10 20 30 40
Kilometers


Ruamahanga Catchment
Baseline Sediment Loss (t/ha/yr)
0.0 - 0.2
0.3 - 0.5
0.6 - 0.8
0.9 - 1.4
1.5 - 2.1
2.2 - 3.1
3.2 - 5.1
5.2 - 8.0
8.1 - 13.5
13.6 - 22.3
N
0 5 10 20 30 40
Kilometers

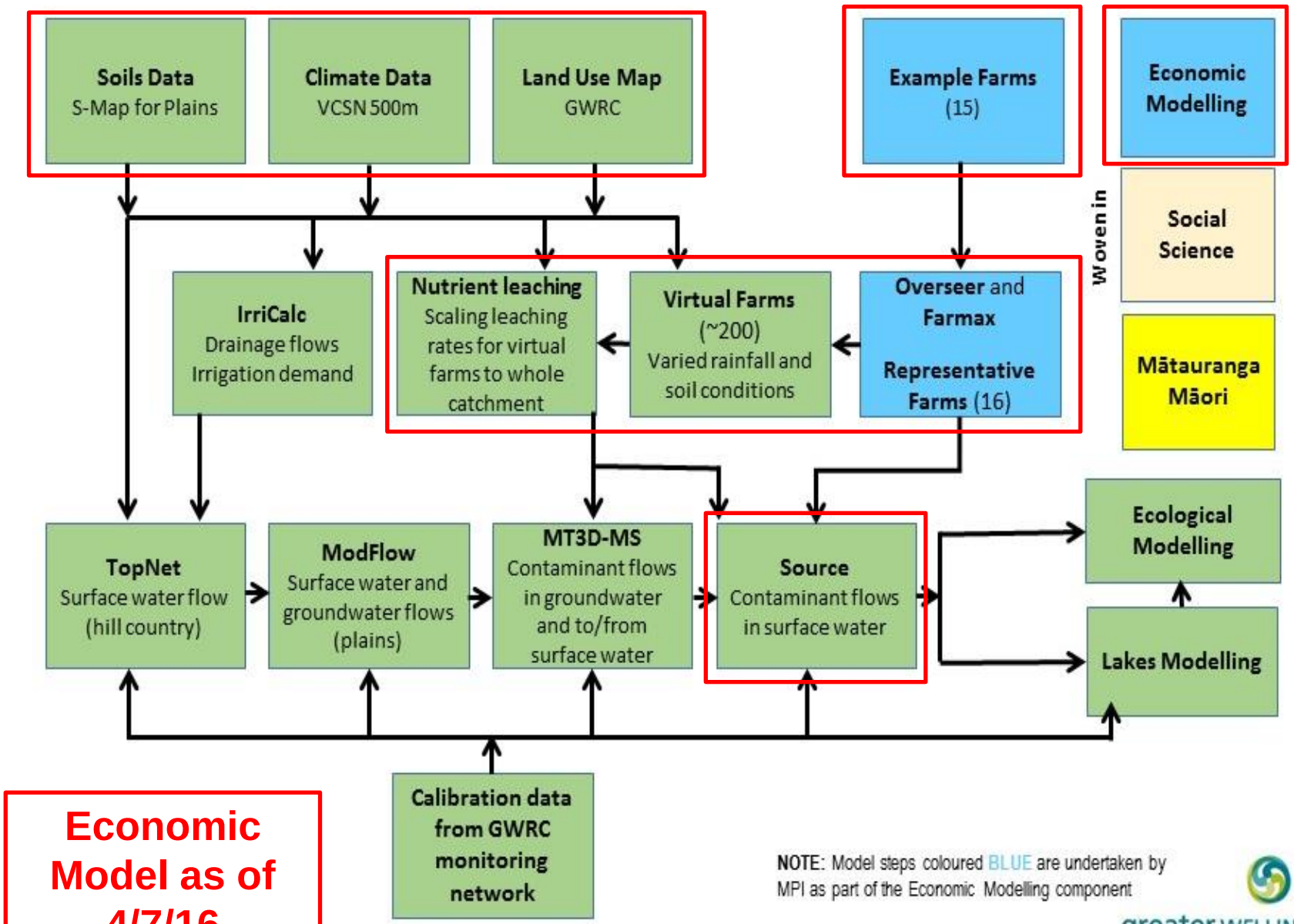

Ruamahanga Catchment
E.coli Loads (peta/yr)
ECOLI
-0.1 - 0.2
0.3 - 0.5
0.6 - 1.1
1.2 - 2.1
2.2 - 3.3
3.4 - 5.3
5.4 - 10.5
10.6 - 19.2
19.3 - 32.0
N
0 5 10 20 30 40
Kilometers

Key Ruamāhanga catchment economic model baseline estimates

Aggregated Land Use	Area (ha)	Net Farm Revenue ($)	N leaching (t)	P loss (t)	Sediment (kt)	E.coli (peta)
Dairy	35,739	66,499,471	1,045	33	10	28
Dairy Support	14,880	13,066,002	965	16	16	9
Sheep & Beef	154,276	72,496,361	2,045	136	378	74
Other Pasture	2,750	2,354,785	52	1	5	1
Forestry	11,306	5,174,823	34	2	23	3
Mixed (Arable)	16,742	27,623,821	653	7	7	4
Horticulture	2,352	13,202,910	20	0	0	1
Native Bush	85,843	0	86	9	365	4
Lifestyle	12,207	0	330	5	4	7
Other	22,898	0	56	0	4	3
Ruamahanga Total	**358,993**	**$200,417,788**	**5285**	**209**	**813**	**135**

NZFARM test scenarios for the Ruamāhanga catchment

Scenario Name	Description	N Leach Target	P Loss Target	Sediment Target	E. coli Target
Management Actions					
All Farms M1	All dairy, sheep & beef, and dairy support farms implement M1 mitigation bundle	n/a	n/a	n/a	n/a
All Farms M2	All dairy, sheep & beef, and dairy support farms implement M2 mitigation bundle	n/a	n/a	n/a	n/a
All Farms M3	All dairy, sheep & beef, and dairy support farms implement M3 mitigation bundle	n/a	n/a	n/a	n/a
Minimum Feasible Loads					
Convert All to Forest	Afforestation of all non-native land in the catchment to estimate the minimum loads possible	n/a	n/a	n/a	n/a
Contaminant load reduction targets					
10% catchment	10% reduction in N, P, and sediment for entire Ruamahanga catchment	10%	10%	10%	0%
10% FMU	10% reduction in N, P, and sediment for each FMU in the Ruamahanga catchment	10%	10%	10%	0%


Soils Data
S-Map for Plains
Climate Data
VCSN 500m
Land Use Map
GWRC
Example Farms
(15)
Economic Modelling
Woven in
Social Science
IrriCalc
Drainage flows
Irrigation demand
Nutrient leaching
Scaling leaching rates for virtual farms to whole catchment
Virtual Farms
(~200)
Varied rainfall and soil conditions
Overseer and Farmax
Representative Farms (16)
Mātauranga Māori
TopNet
Surface water flow (hill country)
ModFlow
Surface water and groundwater flows (plains)
MT3D-MS
Contaminant flows in groundwater and to/from surface water
Source
Contaminant flows in surface water
Ecological Modelling
Lakes Modelling
Calibration data from GWRC monitoring network
Economic Model as of 4/7/16
NOTE: Model steps coloured BLUE are undertaken by MPI as part of the Economic Modelling component
greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Methodology