Overview of IDEAS modelling

Integrated Dynamic Environmental Assessment System

Presenters:

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Anthony Cole
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(Landcare Research)

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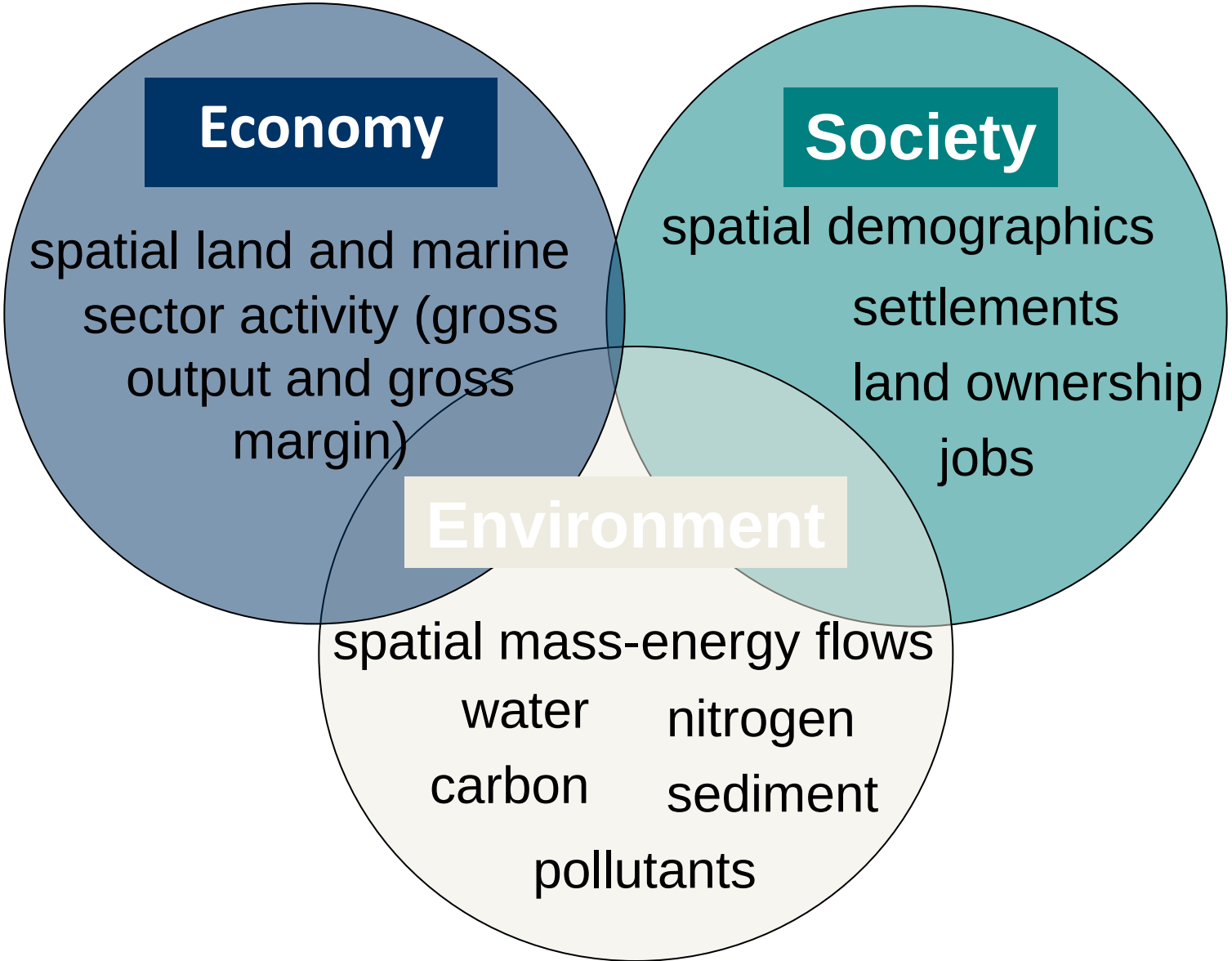
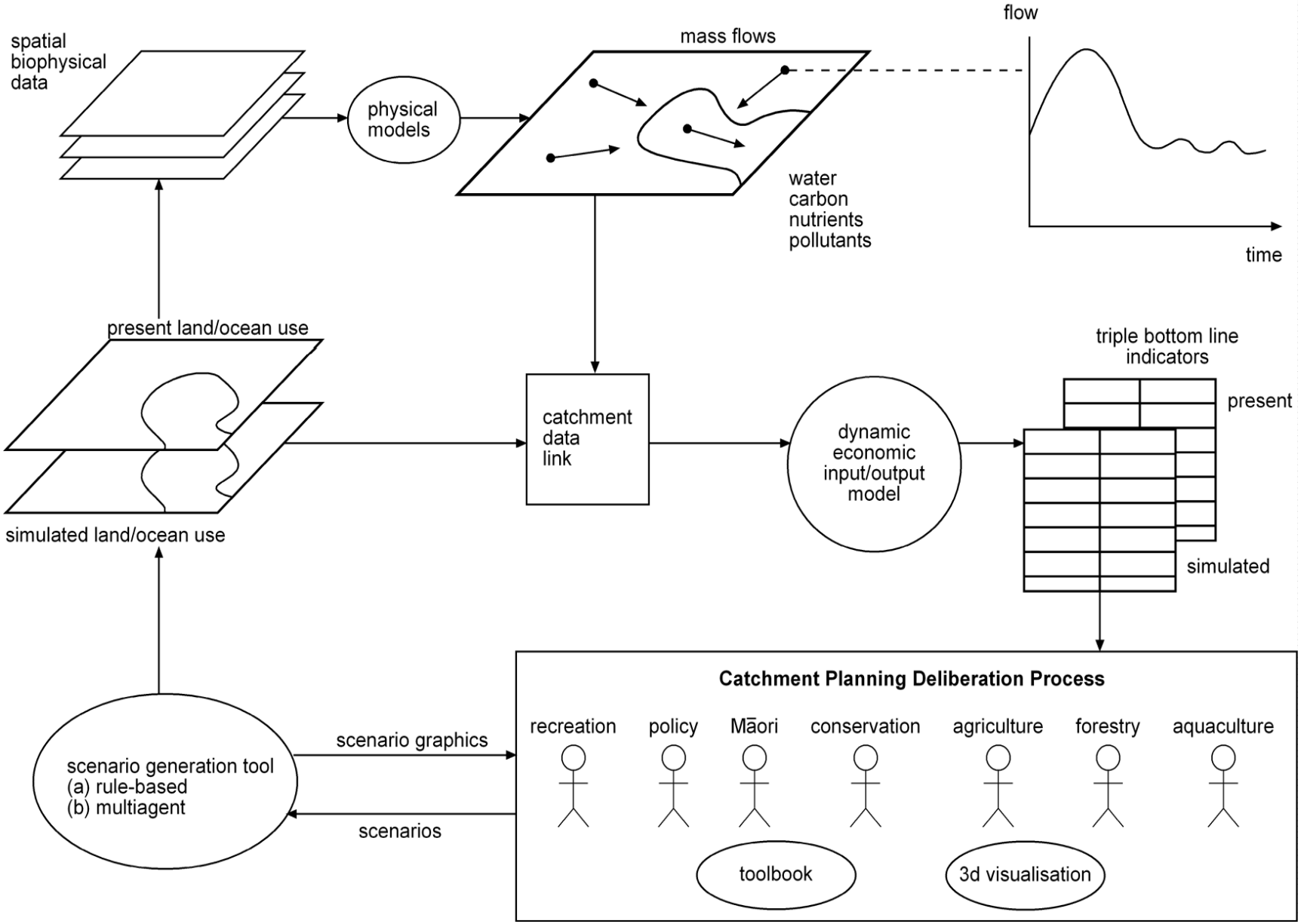
(Cawthron Institute)

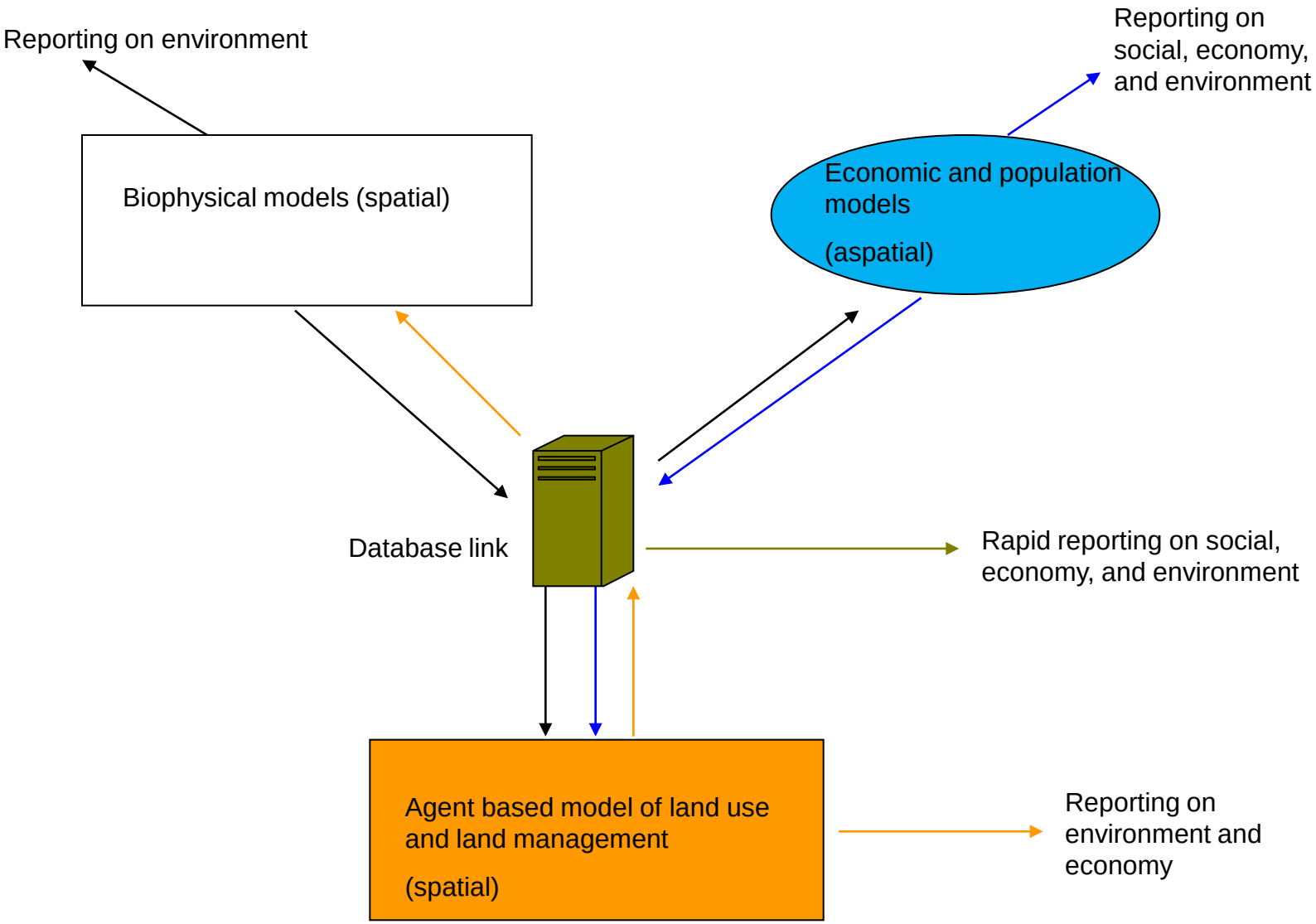
Triple bottom-line approach



IDEAS helps facilitate catchment planning



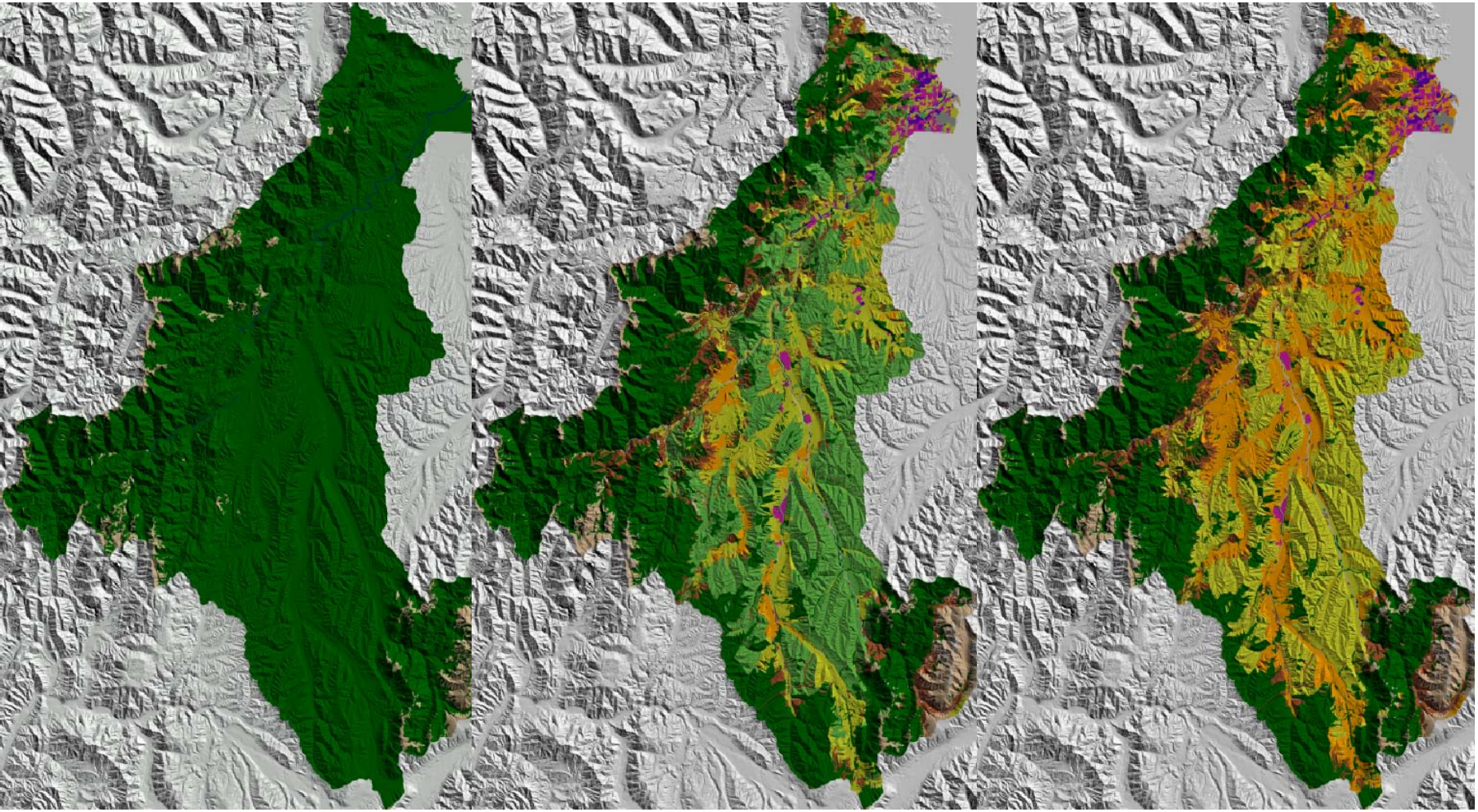
Model linkages in IDEAS



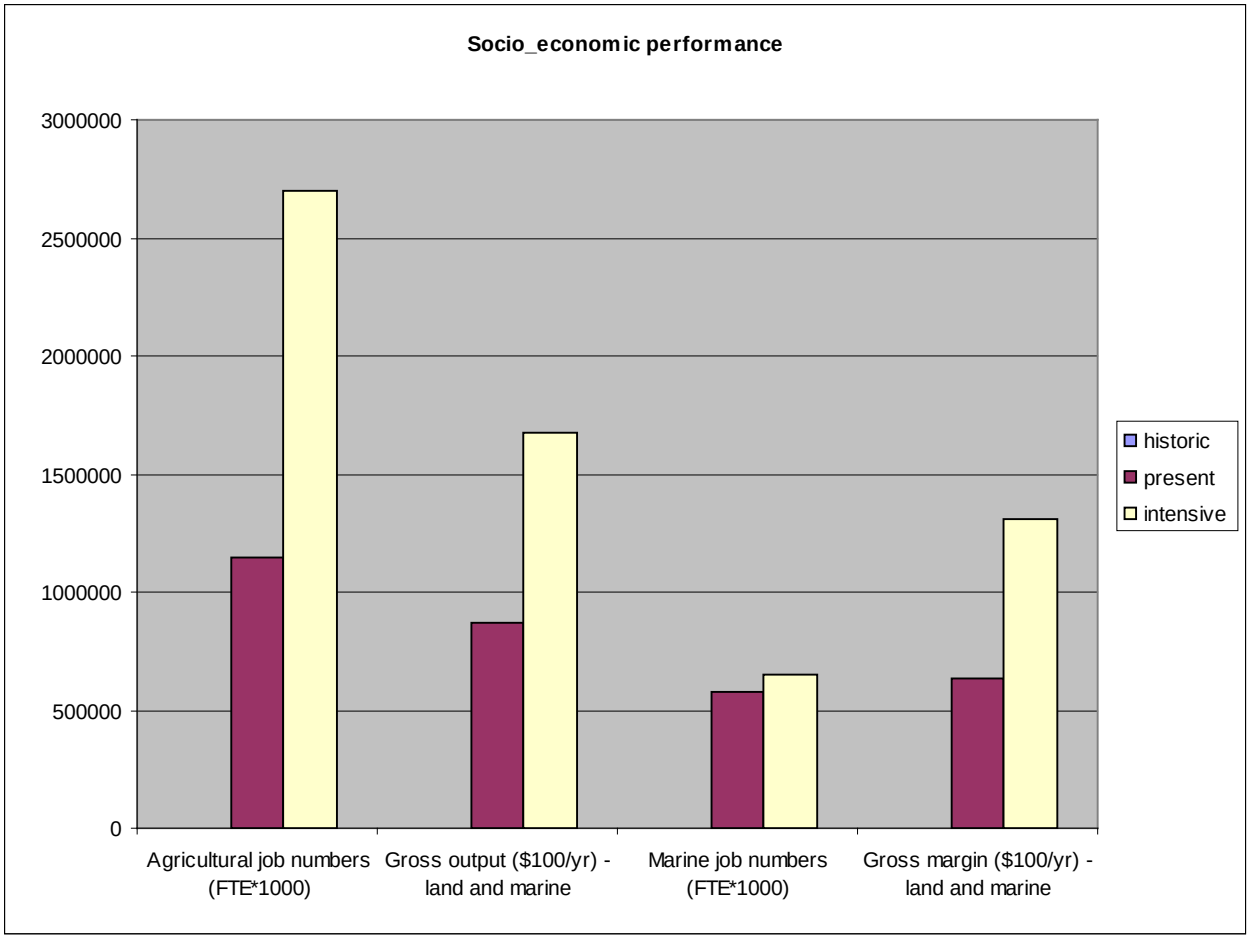
Environmental intensity of nitrogen export (kg/ha/yr).

	historic	present	intensive	present b.m.p.	intensive b.m.p.
cropland/horticulture	0.0	1.7	1.7	1.7	1.7
sheep/beef farming	0.0	0.5	3.0	0.4	2.1
dairy farming	0.0	7.8	18.8	5.5	13.2
scrub	1.0	1.2	1.2	1.2	1.2
tussock grassland	0.0	0.0	0.0	0.0	0.0
production forest	0.0	4.0	4.0	4.0	4.0
indigenous forest	1.8	1.8	1.8	1.8	1.8

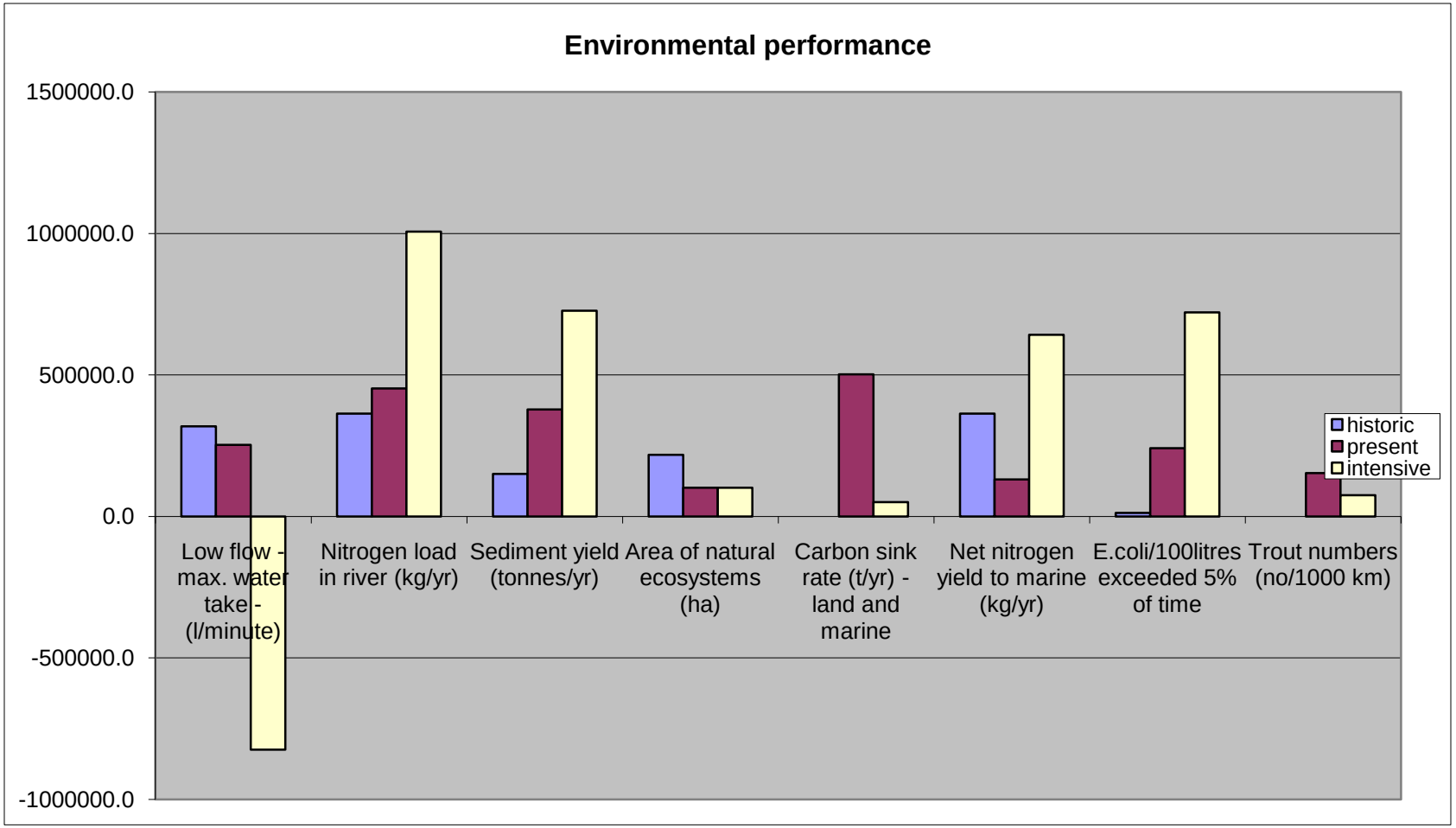
Natural – Present – Intensive land use scenarios



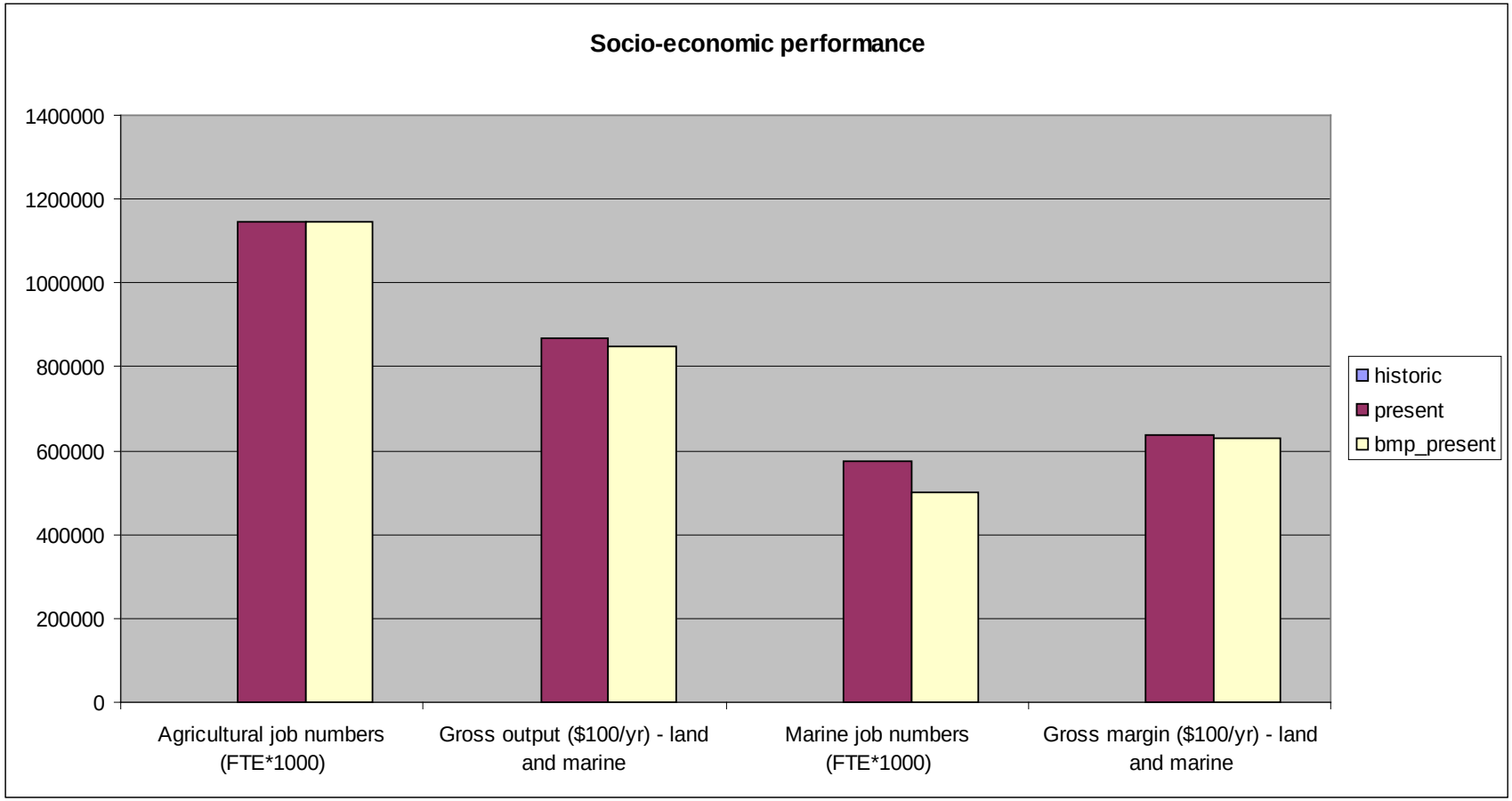
Intensive land use socio-economic outcomes



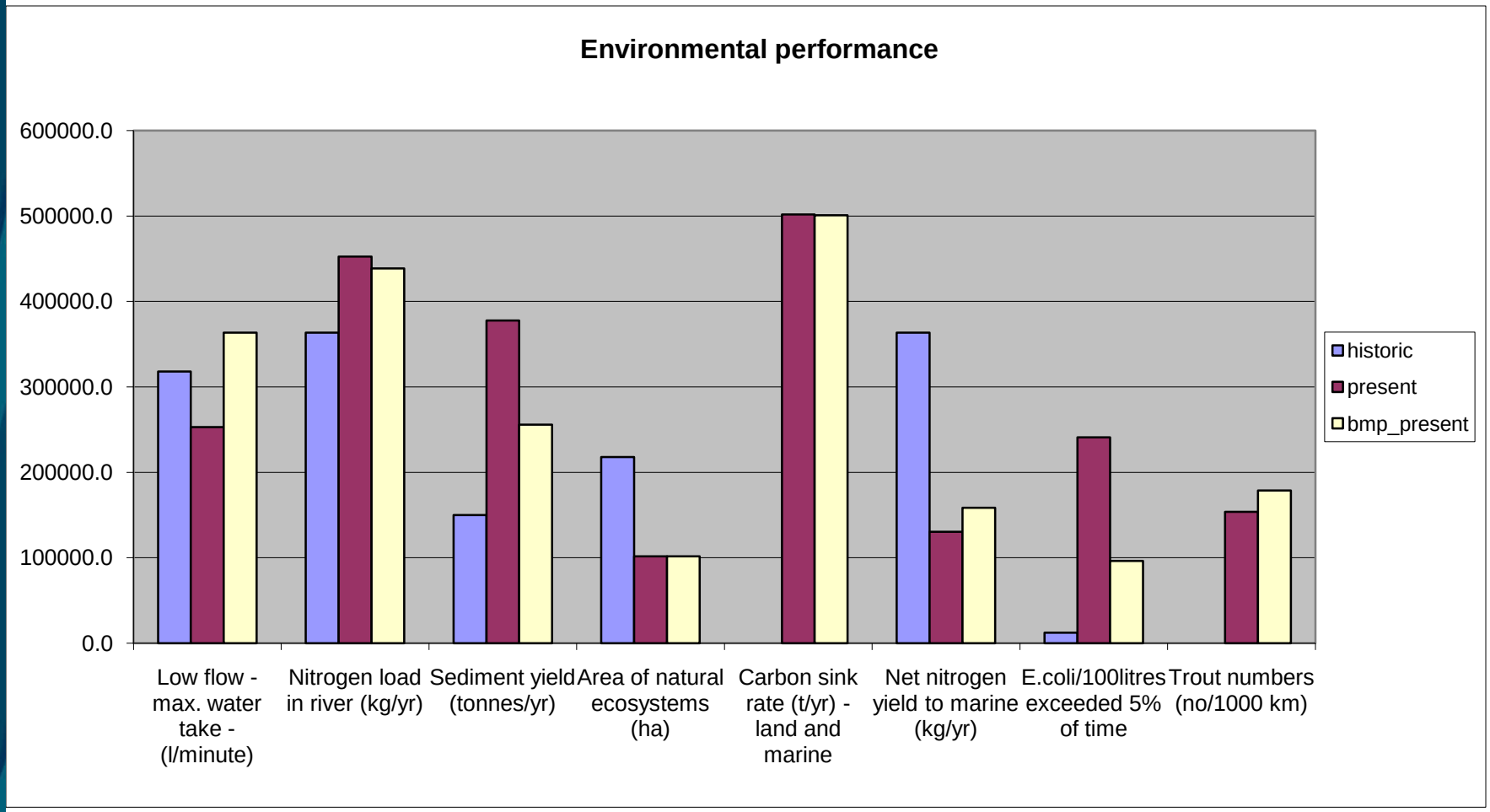
Intensive land use environmental outcomes



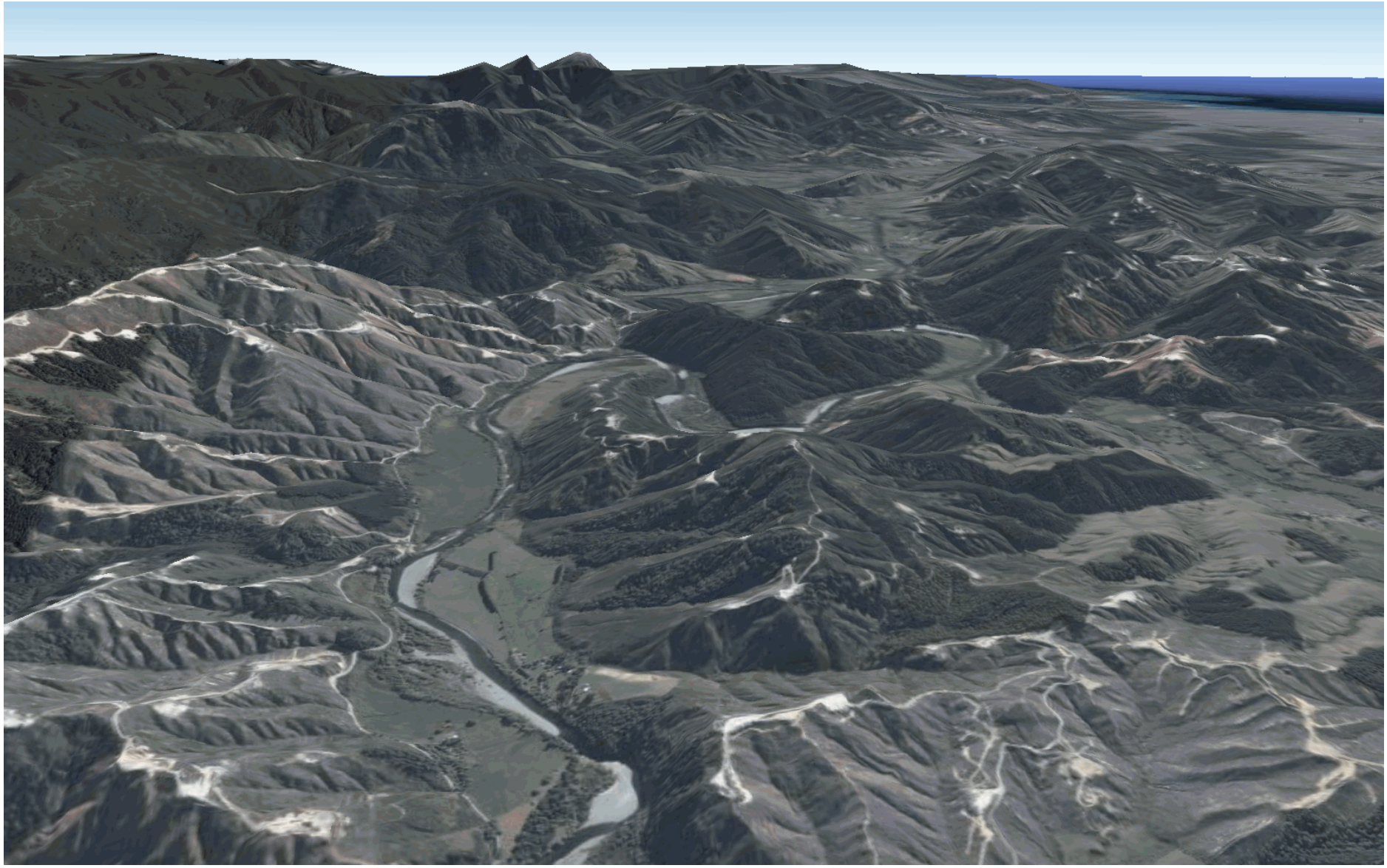
Best management practice

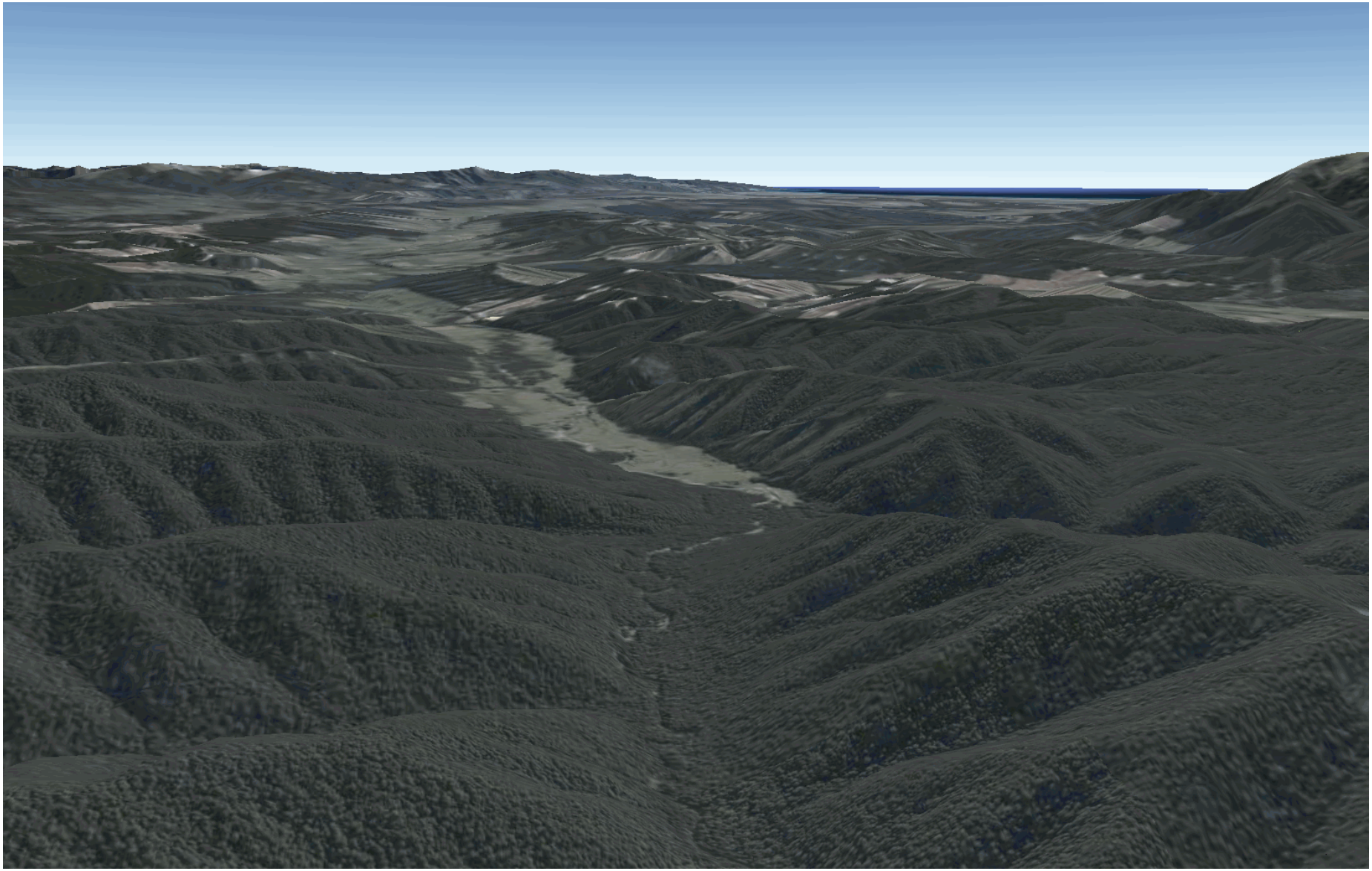


Best management practice




Motueka, New Zealand



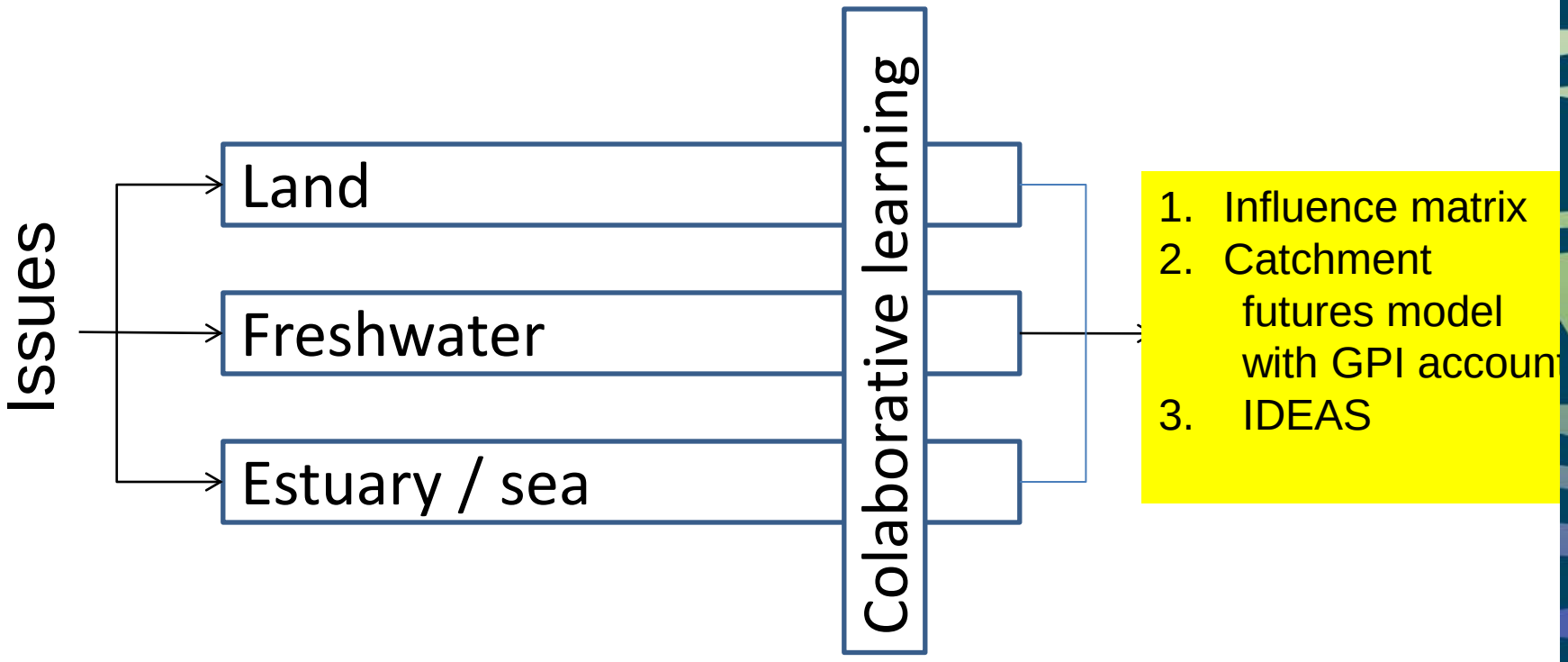


Catchment futures modelling

What development scenarios for the Motueka catchment

environment - economy - social system are sustainable?

The ICM programme

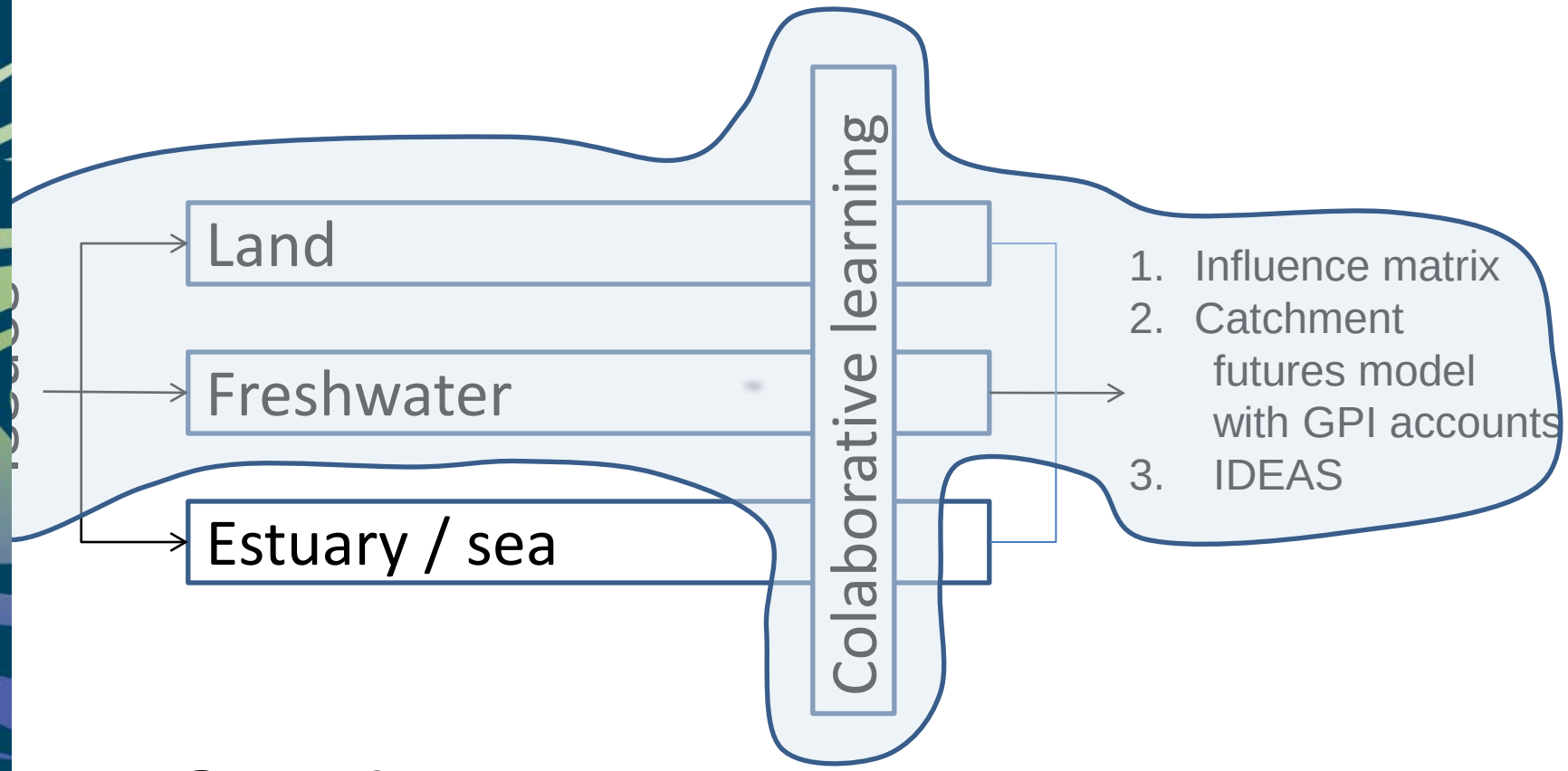


State & response

Human dimension

Integration & innovation

The ICM programme



State & response

Human dimension

Integration & innovation

Catchment futures modelling results

- Only ***one line of evidence*** (sustainability)
- Business-as-usual run is not sustainable
  - Indicators (illustrate)
- Question – what does sustainable catchment development look like?

Contents

- Motueka catchment futures
- Origin of the model
- The business-as-usual model run
- Social indicators
- Conclusions
- Conclusions – building a sustainable scenario
- Supporting material – if required

Motueka catchment futures model

What is it?

This futures model

- Mathematical description
- Holistic
- Model parts are interconnected
- Run model scenarios (explore system change)
- Sustainability accounting tool

Origin of the model

Why did we build this?

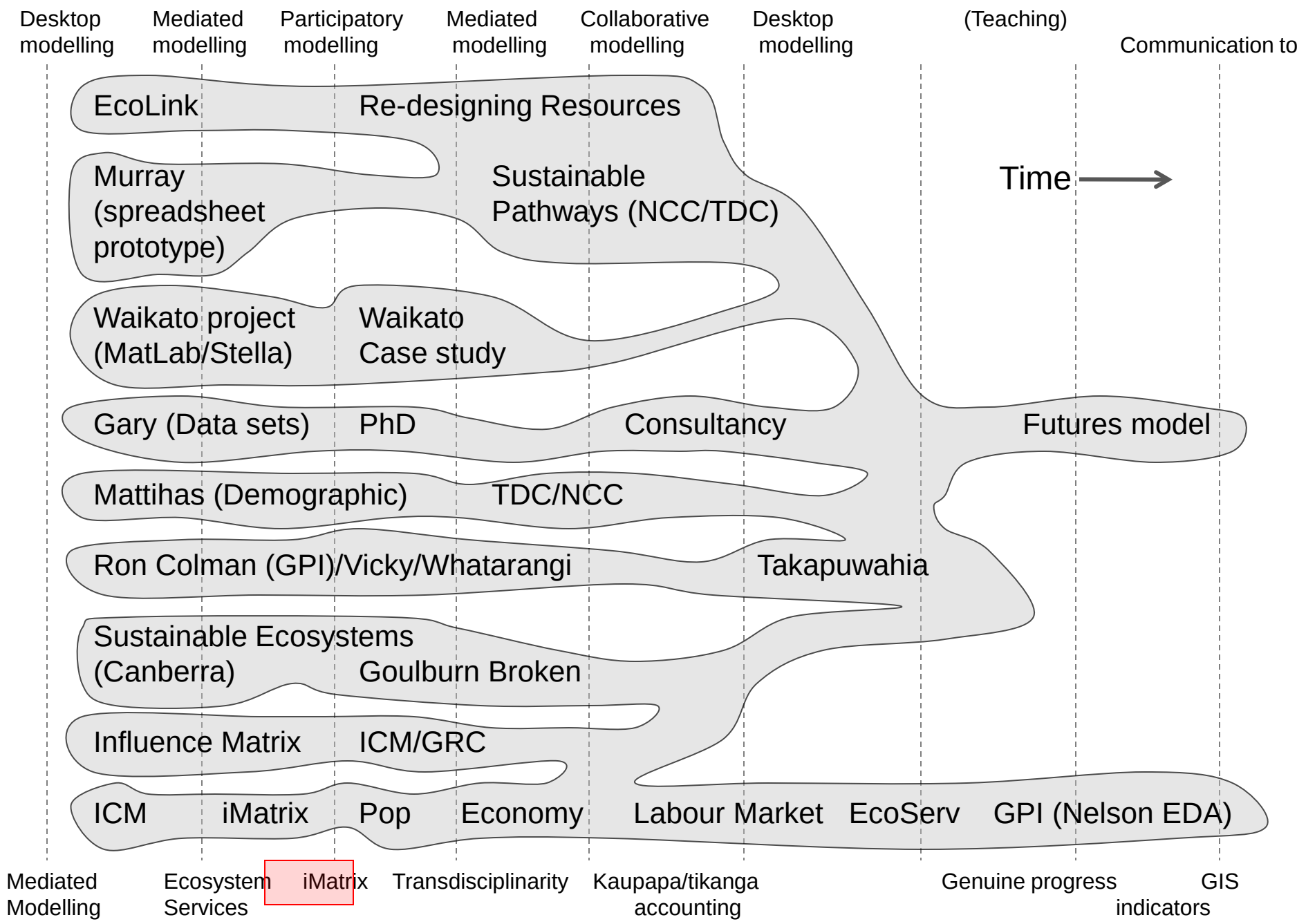
Where did this all start?

- Motueka Community Reference Group (CRG)
- Influence matrix project
  - *Catchment development goals (esp. sustainability)*
  - *Preferred developmental factors*
- The futures model was the next step

Goal identification

"The residents of the Motueka Catchment want to manage their Catchment so as to ensure they continue to enjoy a safe place to play and live, its pristine character and beauty, its identity, economic and ecological balance, its economic viability for business development, its exceptional climate, biological, community and landscape diversity & coastal integrity"

Motueka community reference group (6/5/02)


Desktop modelling
Mediated modelling
Participatory modelling
Mediated modelling
Collaborative modelling
Desktop modelling
(Teaching)
Communication to
EcoLink
Re-designing Resources
Murray (spreadsheet prototype)
Sustainable Pathways (NCC/TDC)
Time
Waikato project (MatLab/Stella)
Waikato Case study
Gary (Data sets)
PhD
Consultancy
Futures model
Mattihas (Demographic)
TDC/NCC
Ron Colman (GPI)/Vicky/Whatarangi
Takapuwahia
Sustainable Ecosystems (Canberra)
Goulburn Broken
Influence Matrix
ICM/GRC
ICM
iMatrix
Pop
Economy
Labour Market
EcoServ
GPI (Nelson EDA)
Mediated Modelling
Ecosystem Services
iMatrix
Transdisciplinarity
Kaupapa/tikanga accounting
Genuine progress indicators
GIS

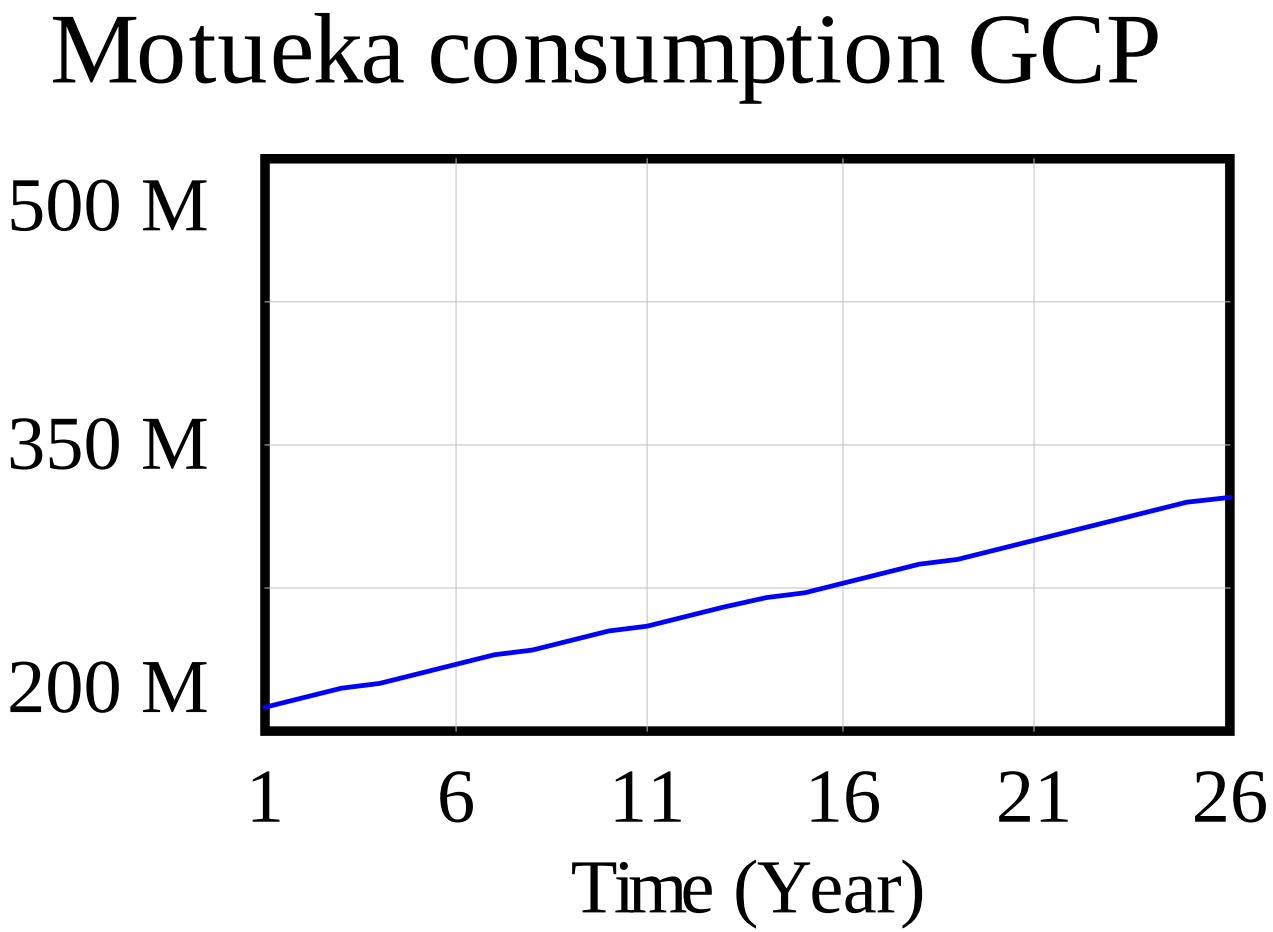
The business-as-usual model run

What have we discovered?

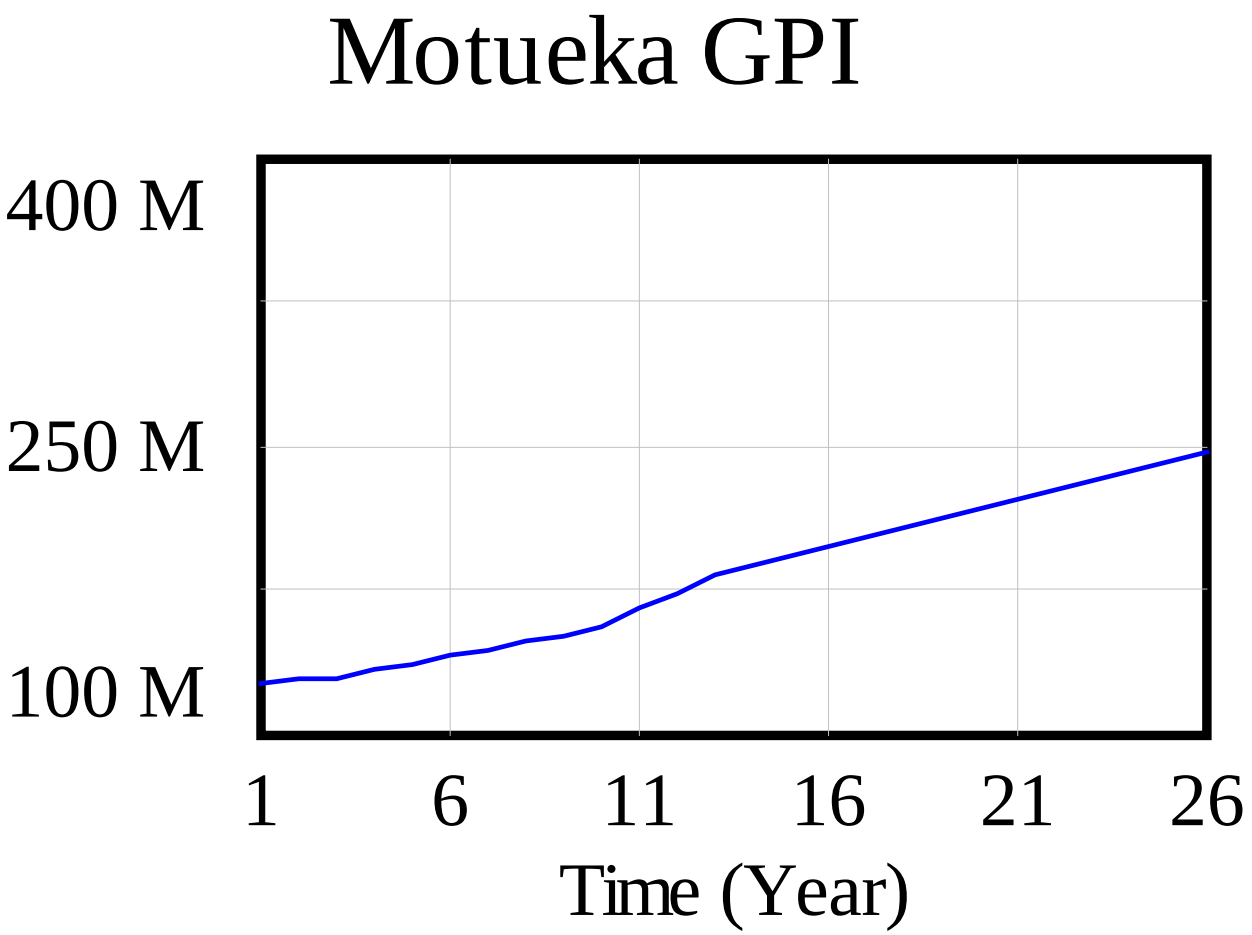
Let’s assume business-as-usual growth

- Our key question – “are we on track?”
- Focus on emerging tensions

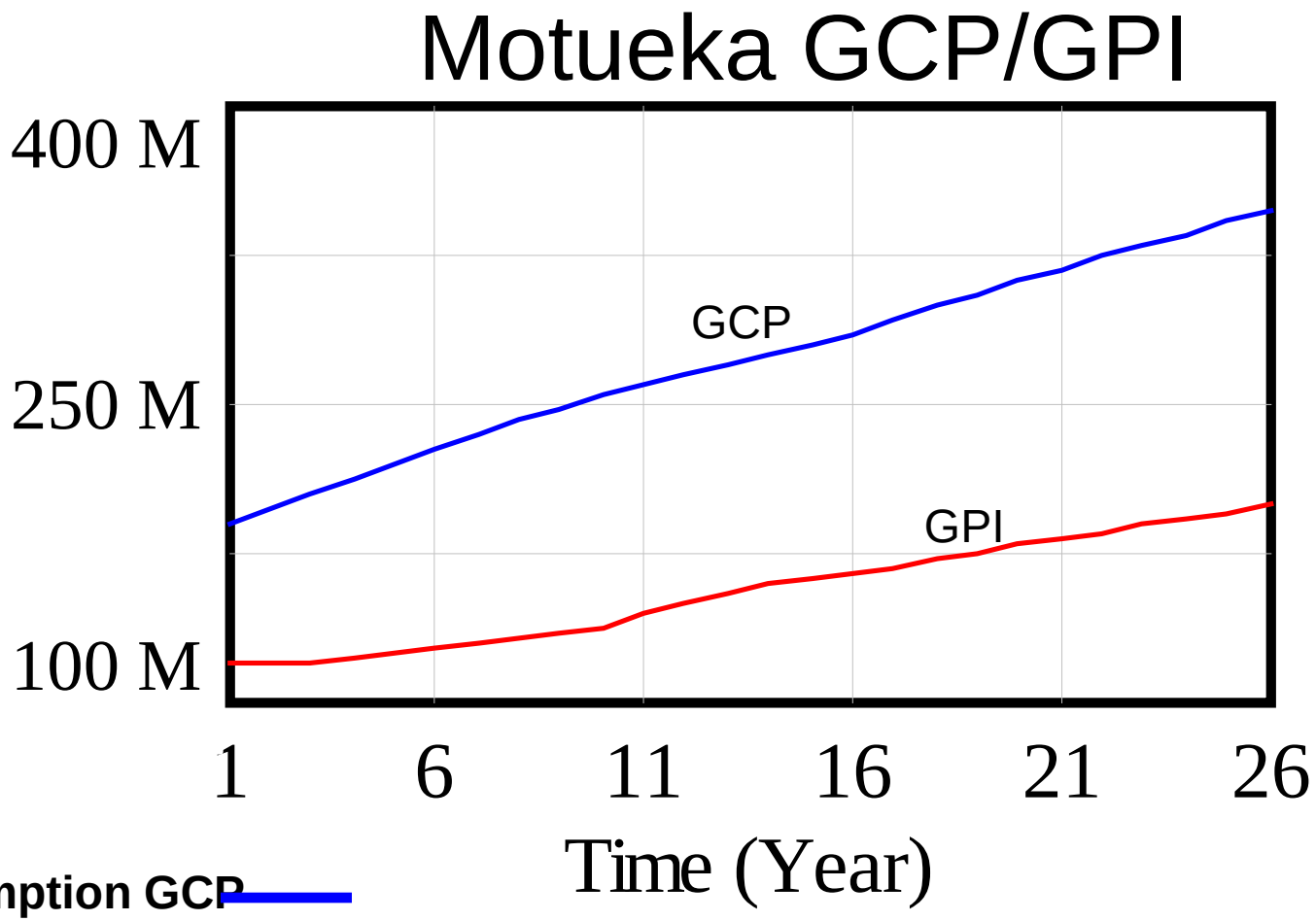
How much economic growth?



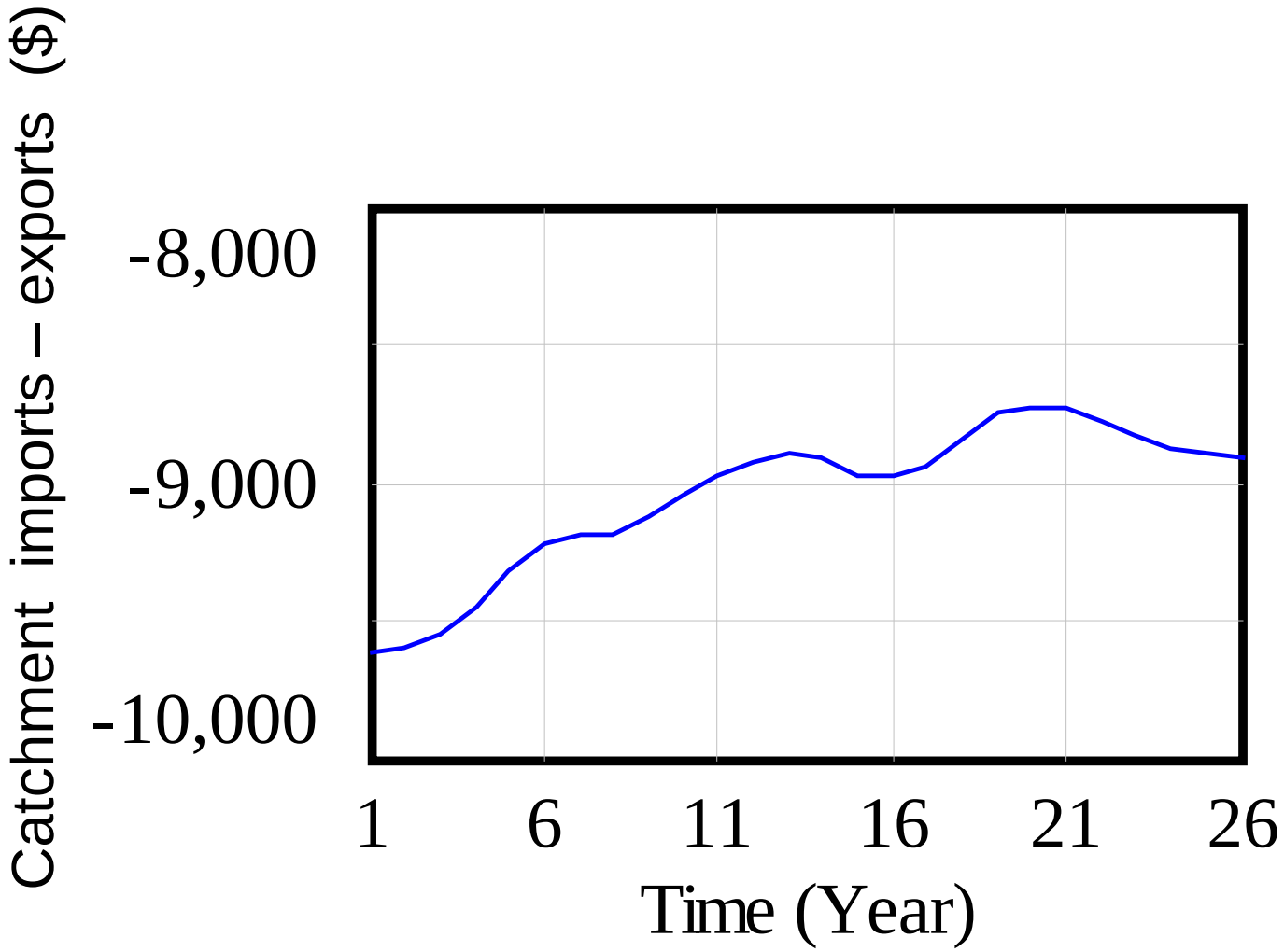
Estimating genuine progress



> economic growth ≠ wellbeing improvements (social / ecological)



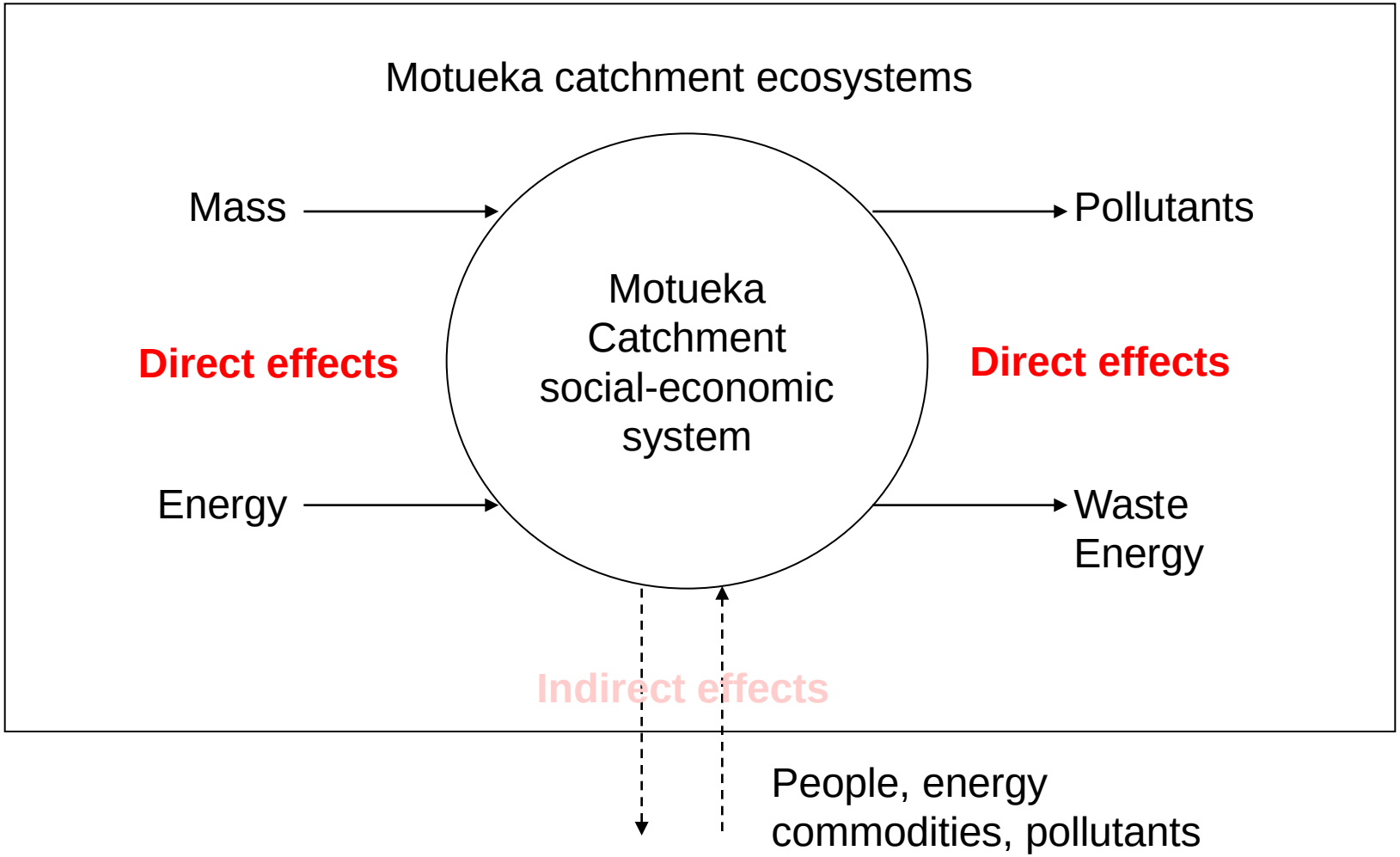
Balance of trade/capita



Direct material & energy flows

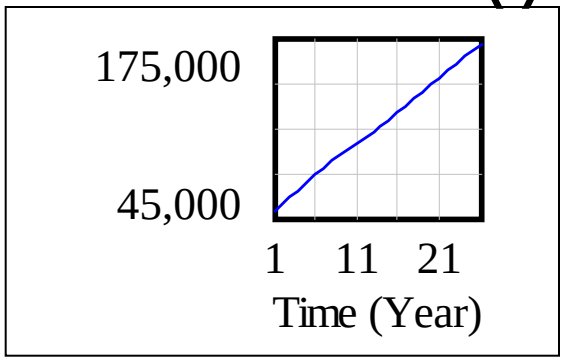
Industry and household

The basic model concept

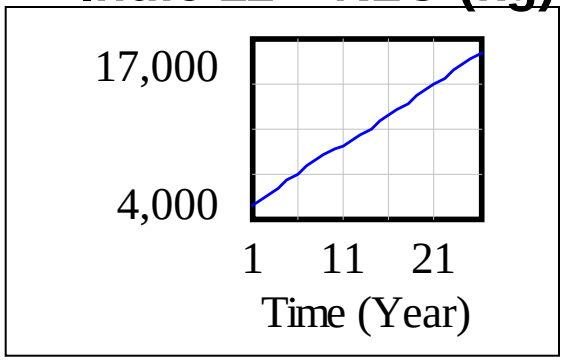


Direct material flows (industry)

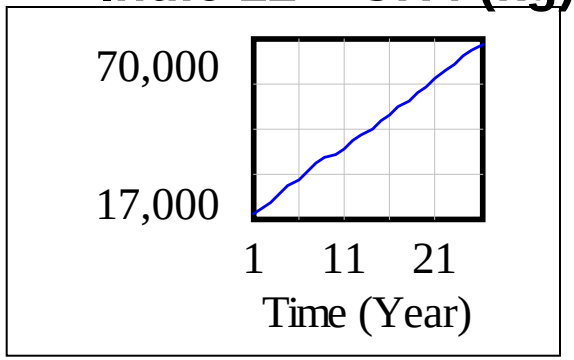
Indic 10 – CO2 (t)



Indic 11 – N2O (kg)

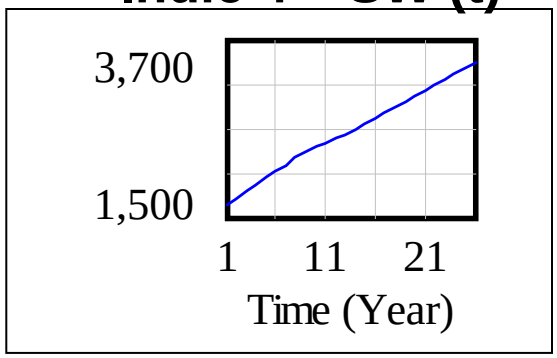


Indic 12 – CH4 (kg)



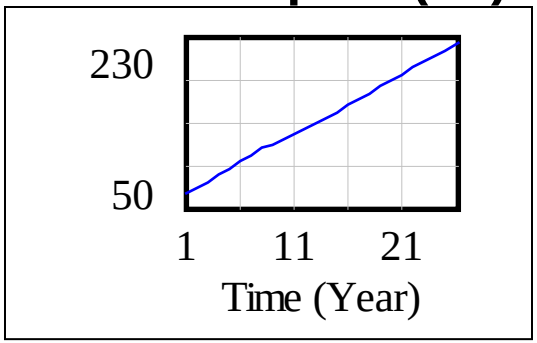
GHG emissions

Indic 4 – SW (t)



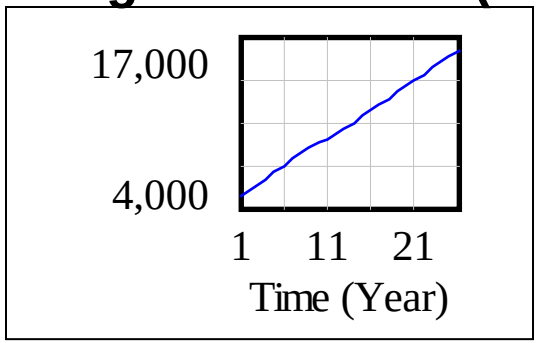
Offset direct (industry) GHG emissions

Exotic pine (ha)



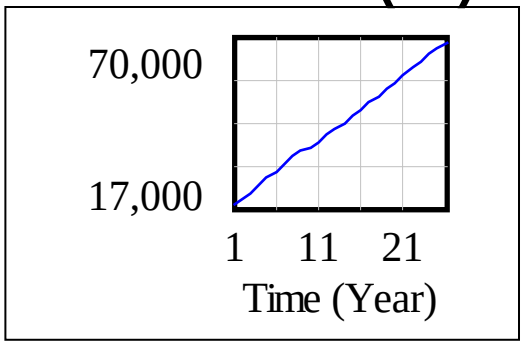
Option 1

Indigenous forest (ha)



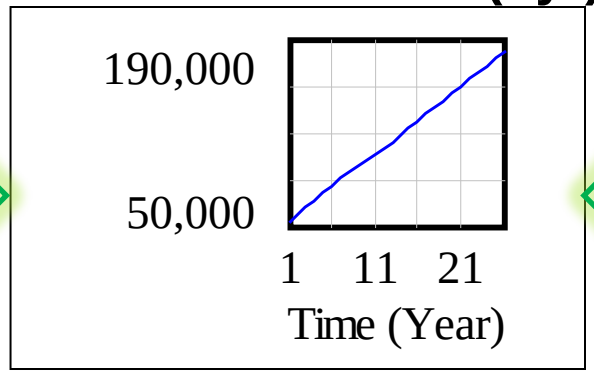
Option 2

Hard beech (ha)



Opti

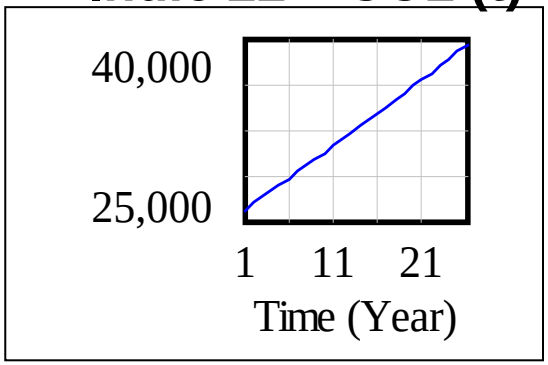
Total direct CO2 (t/yr)



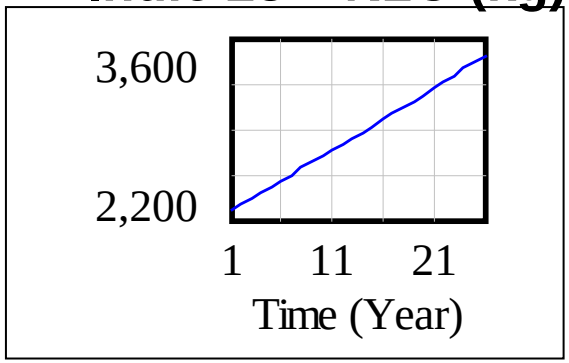
GHG emissions as CO2 equivalent

Direct material flows (Household)

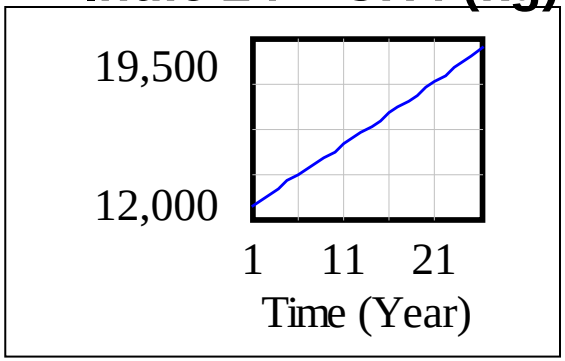
Indic 22 – CO2 (t)



Indic 23 – N2O (kg)

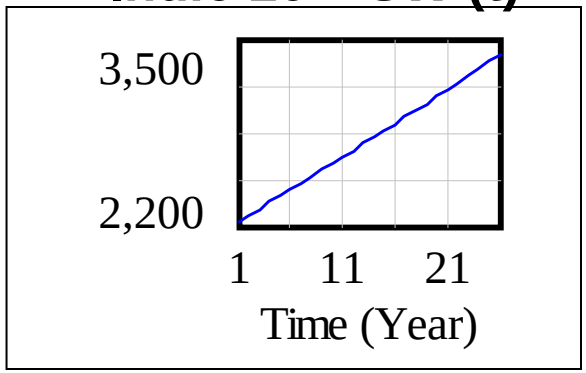


Indic 24 – CH4 (kg)



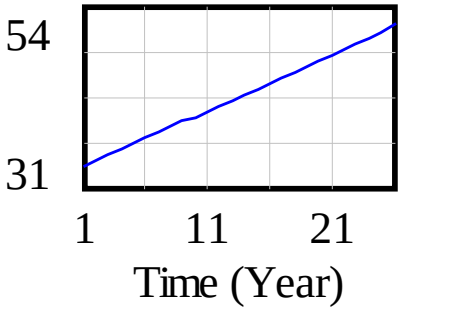
GHG emissions

Indic 16 – SW (t)



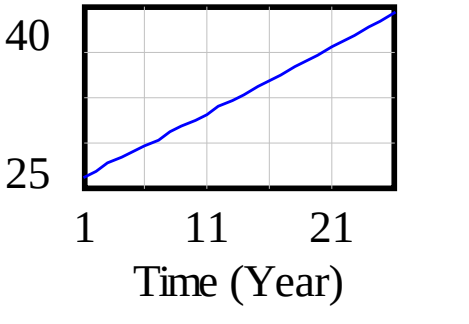
Offset direct (house) GHG emissions

Exotic pine (ha)



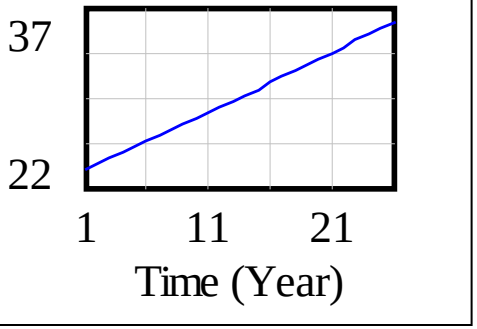
Option 1

Indigenous forest (ha)



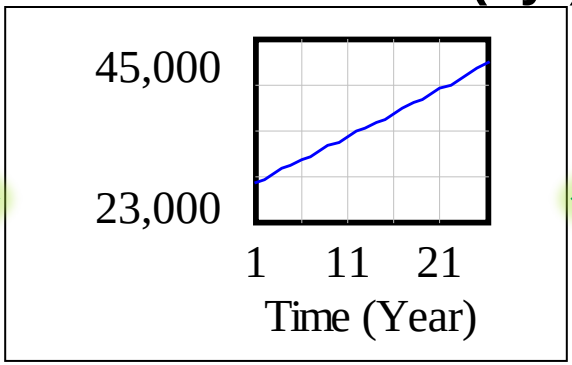
Option 2

Hard beech (ha)



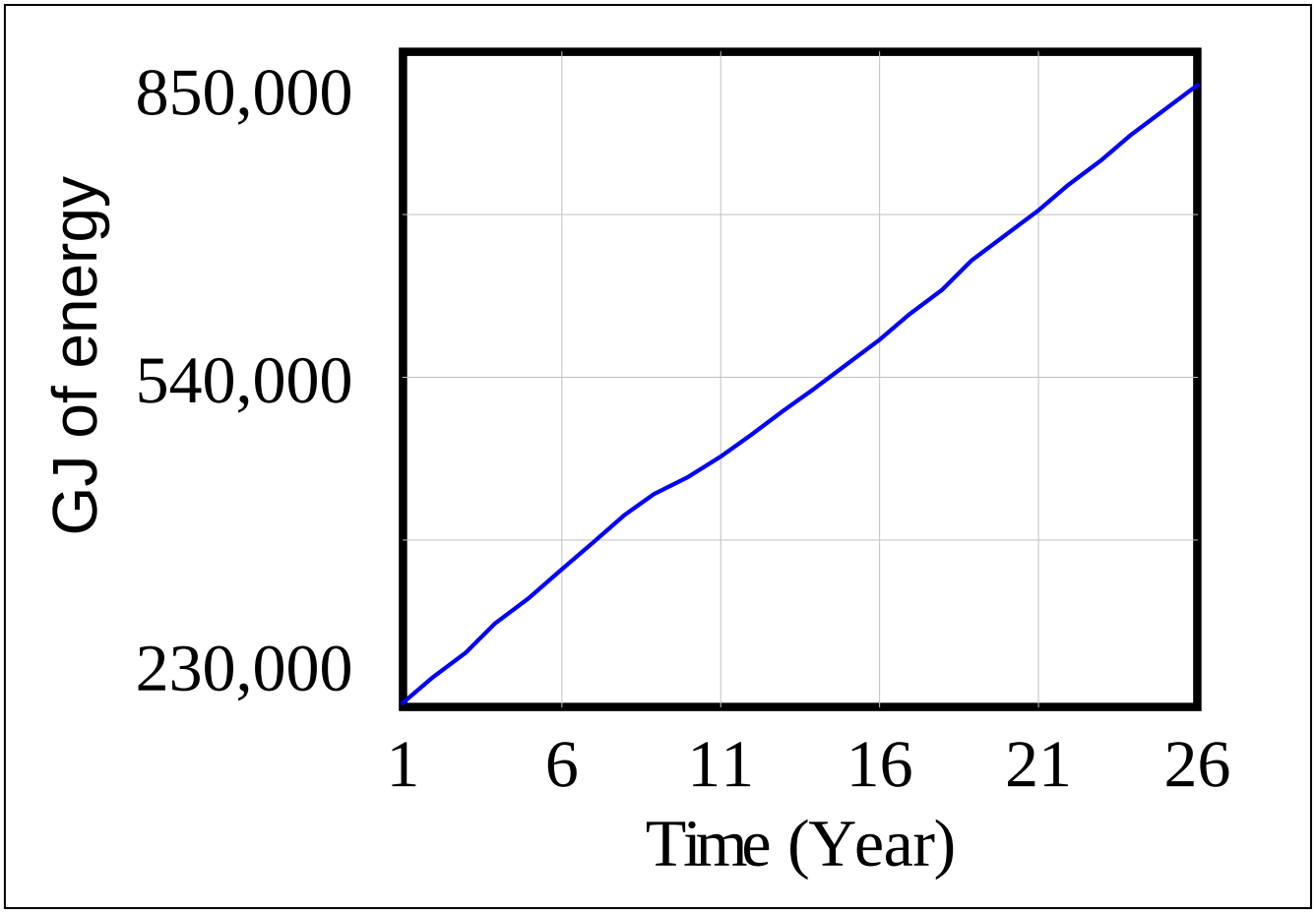
Opti

Total direct CO2 (t/yr)

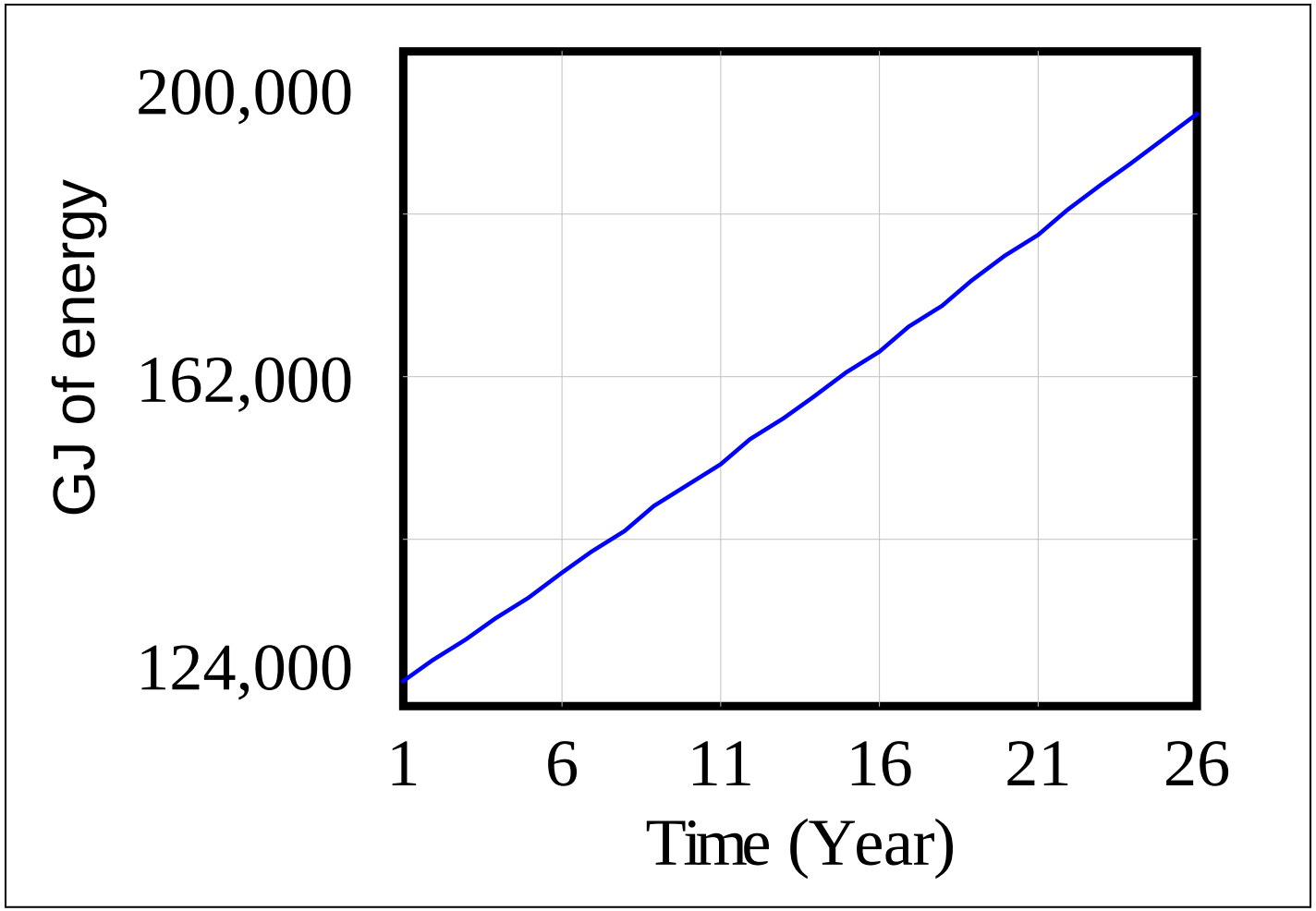


GHG emissions as CO2 equivalent

Direct energy use (industry) GJ/yr



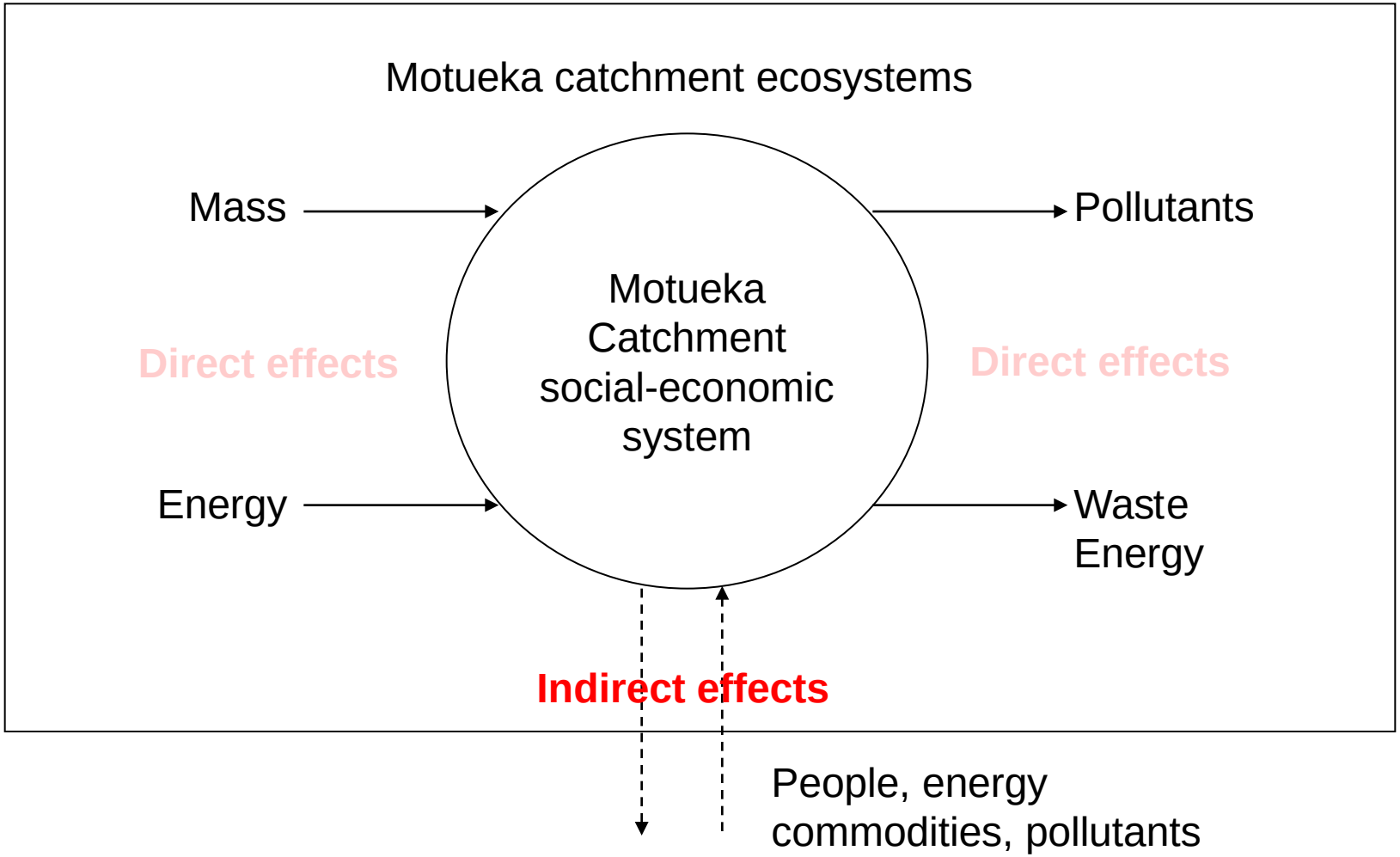
Direct energy use (household) GJ/yr



Indirect material & energy flows

Industry and household

The basic model concept

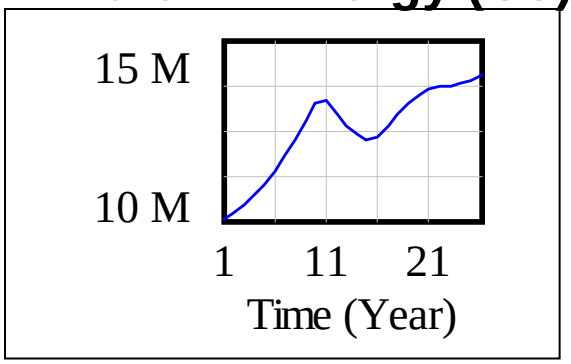


Indirect

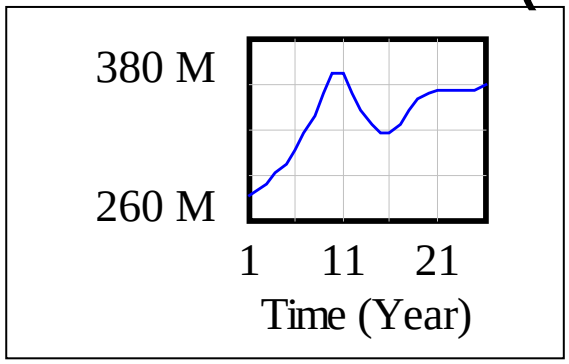
- *Direct* cause and effect is mediated by contributory intermediate steps (*i.e. a chain of events*)
- These should be measured
- Typically account for ca. 90% of the effect
- An *embodied* effect
  - Everything we purchase has embodied water, energy, GHG emissions etc

Indirect material flows (industry)

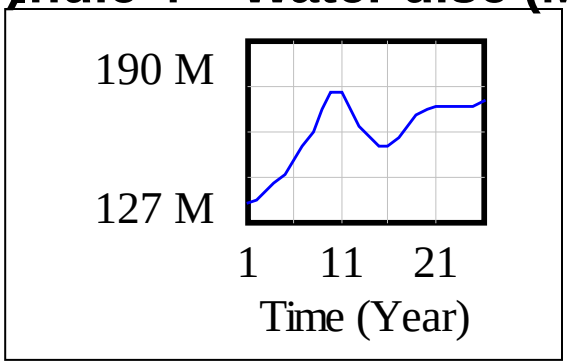
Indic 1 - Energy (GJ)



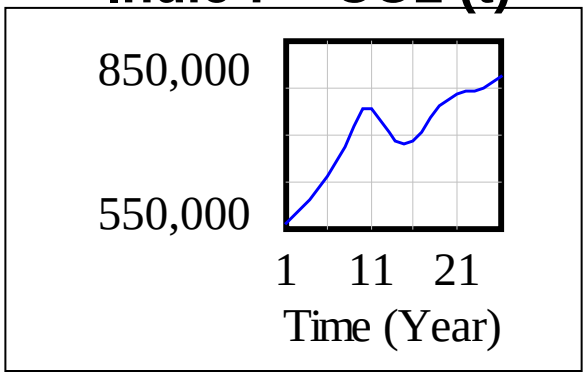
Indic 3 – Water take (M3)



Indic 4 – Water disc (M3)



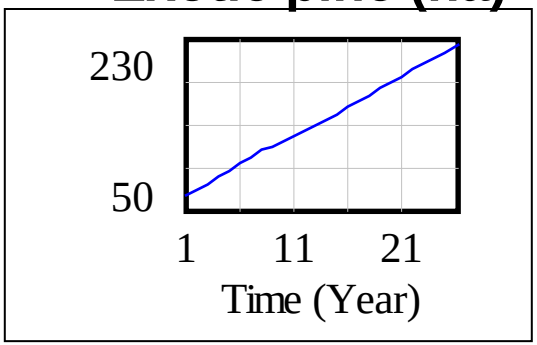
Indic 7 – CO2 (t)



GHG emissions

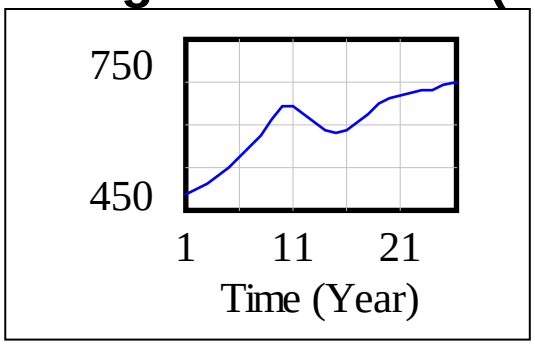
Offset *indirect* (industry) GHG emissions

Exotic pine (ha)



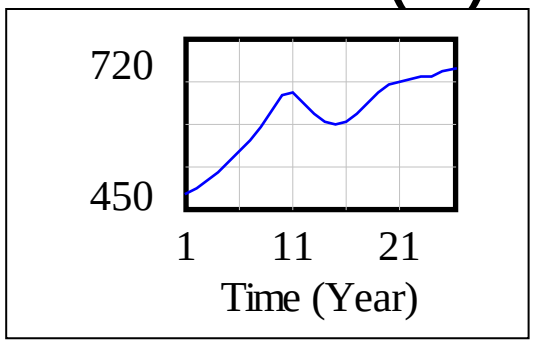
Option 1

Indigenous forest (ha)



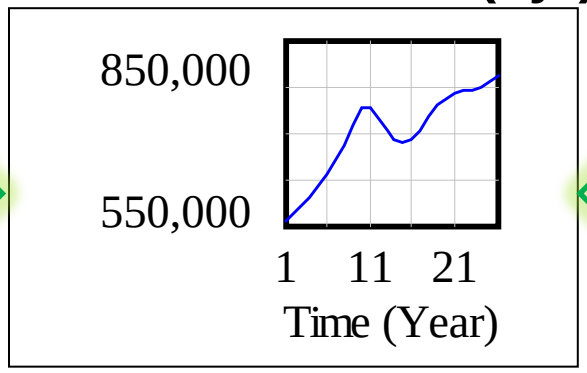
Option 2

Hard beech (ha)



Opti

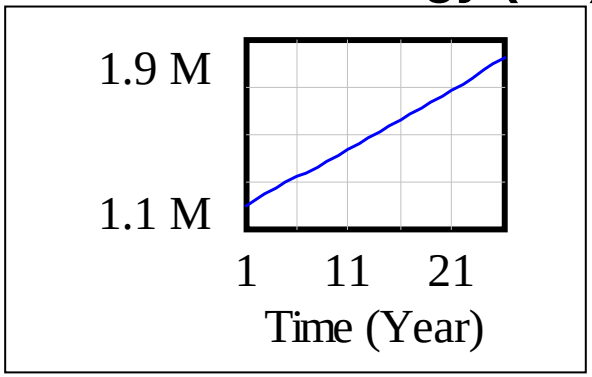
Total direct CO2 (t/yr)



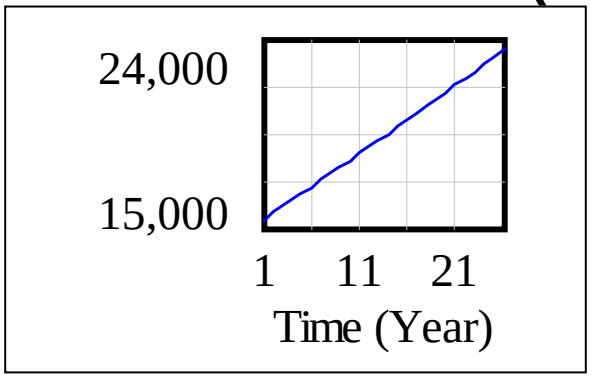
GHG emissions as CO2 equivalent

Indirect material flows (Household)

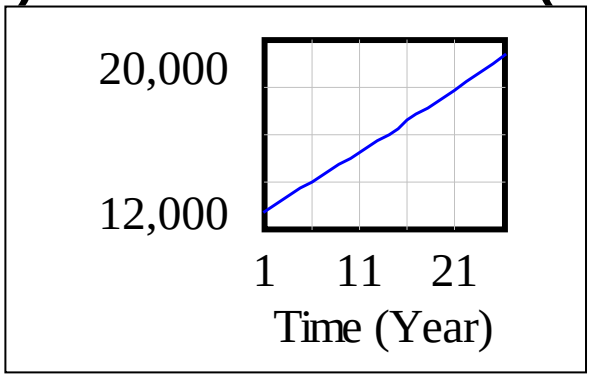
Indic 1 - Energy (GJ)



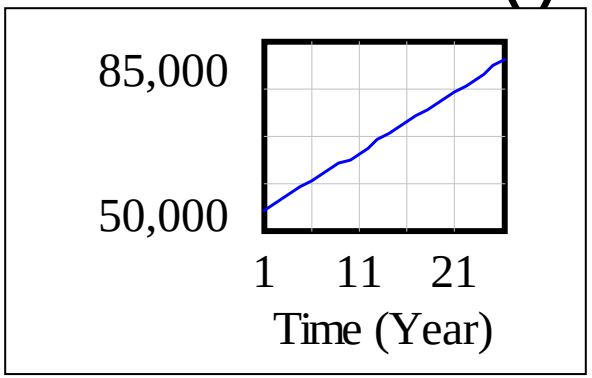
Indic 3 – Water take (M3)



Indic 4 – Water disc (M3)



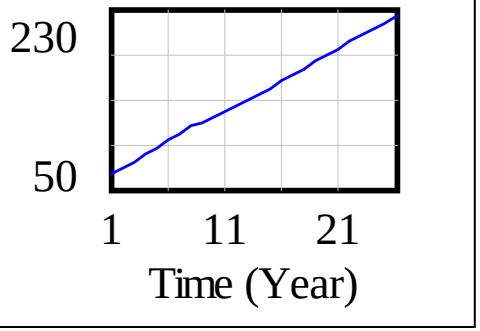
Indic 7 – CO2 (t)



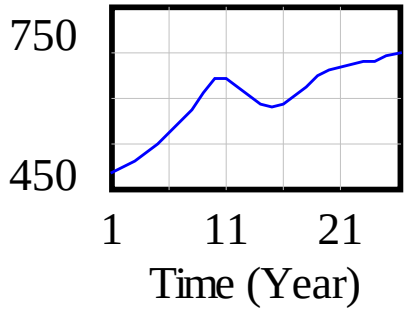
GHG emissions

Offset *indirect* (household) GHG emissions

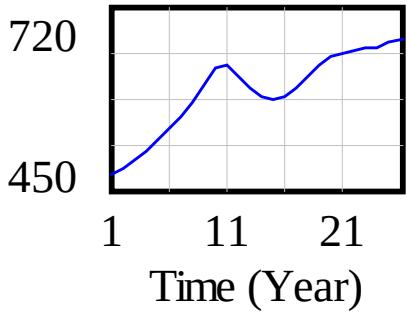
Exotic pine (ha)



Indigenous forest (ha)

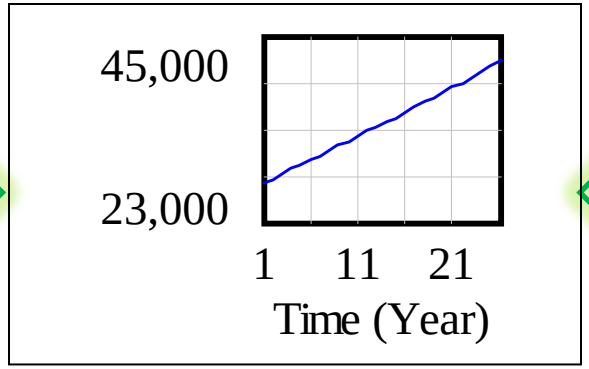


Hard beech (ha)



Option 1 **Option 2** **Opti**

Total direct CO2 (t/yr)



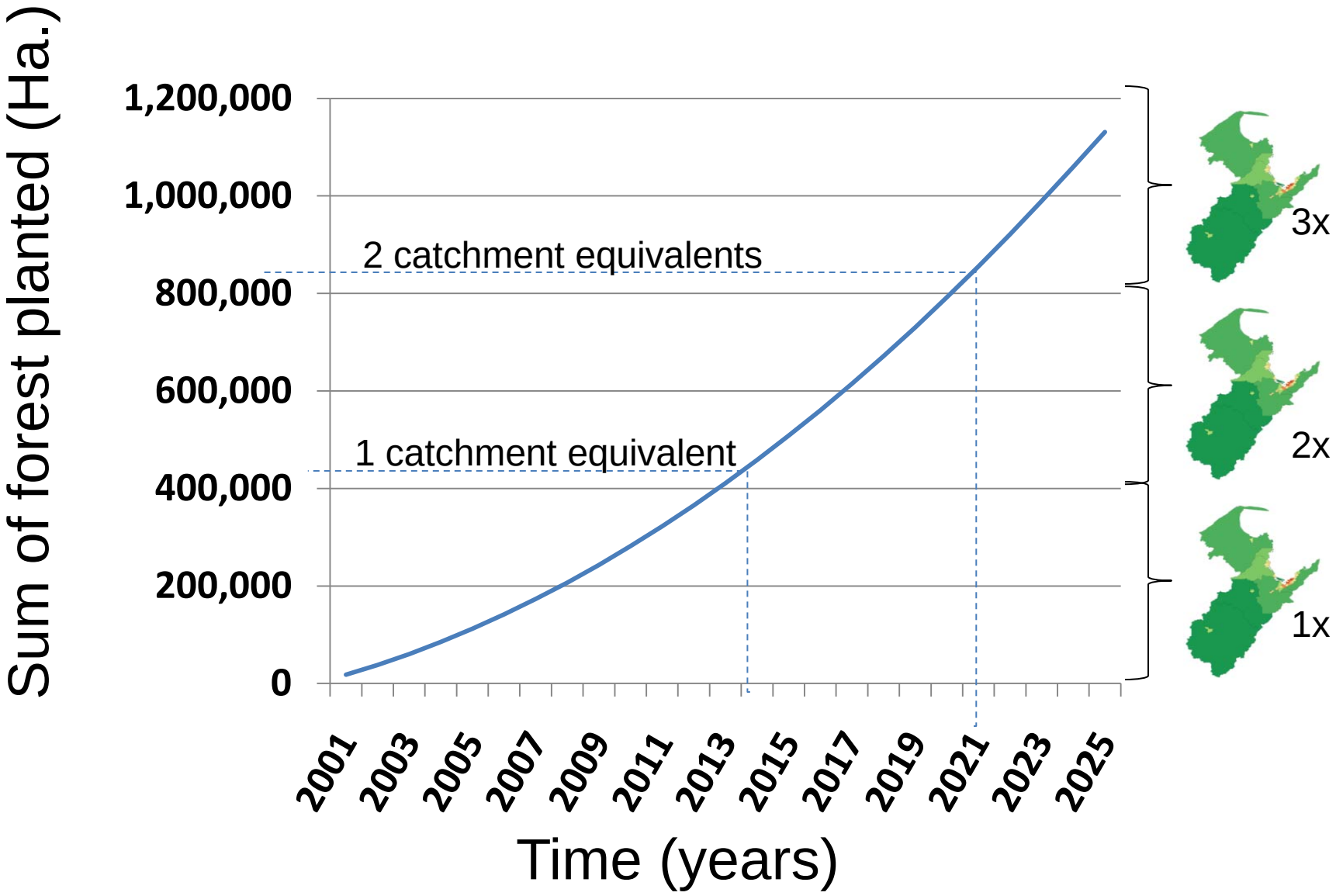
GHG emissions as CO2 equivalent

Summary

- *Direct* offset (industry) 17-70,000 ha/yr
- *Direct* offset (household) 70-80 ha/yr
- *Indirect* offset (industry) 720-750 ha/yr
- *Indirect* offset (household) 70-80 ha/yr

- *Total offset range (yr)* 17,860 – 70,910 ha/yr
- *Time (horizon)* *2001 - 2025*

Sum of annual GHG offset



Social indicators

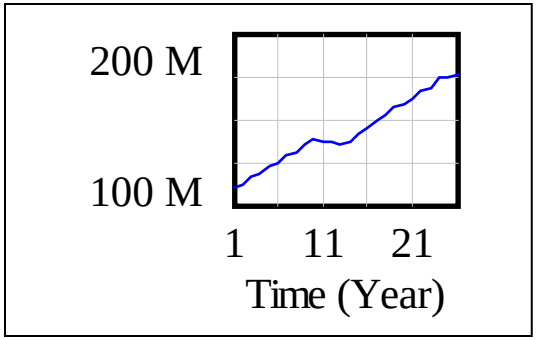
GPI accounts

Social domain

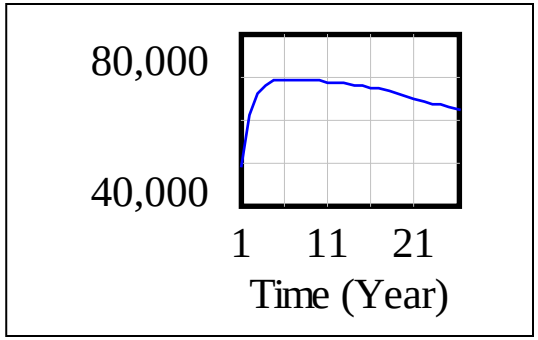
- Economic growth also causes social effects
- Tensions in this area too
- GPI accounts module (monetary)

GPI (Social indicators)

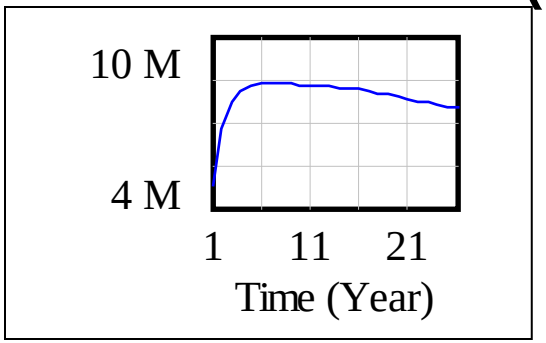
GPI indic 11 – Cons Dur



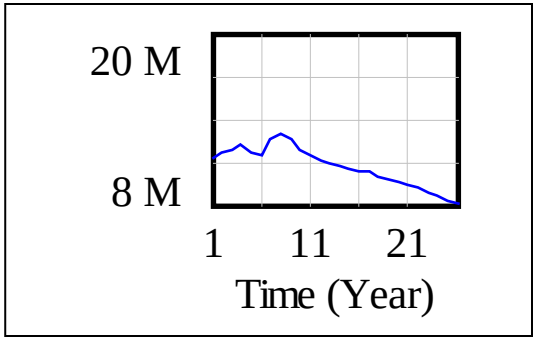
GPI indic 12 – Unemp



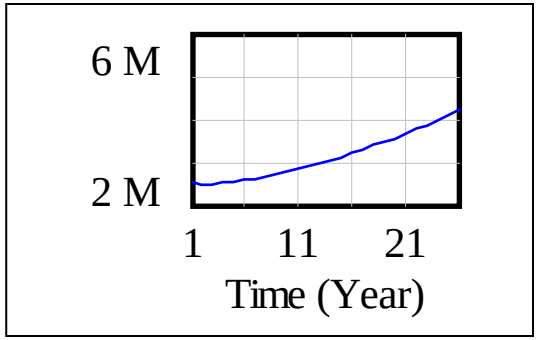
GPI indic 13 – Prod (Un)



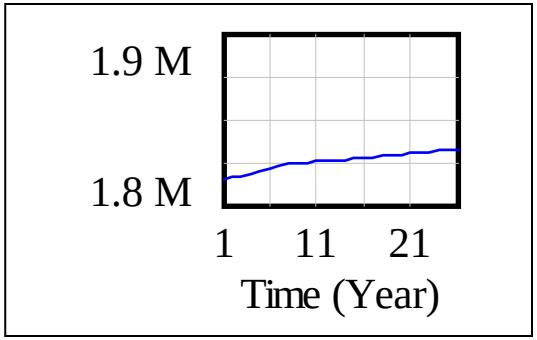
GPI indic 14 – Veh Acc



GPI indic 15 – Commute

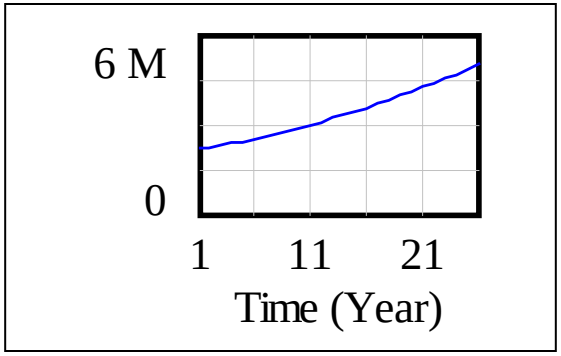


GPI indic 15 – Crime

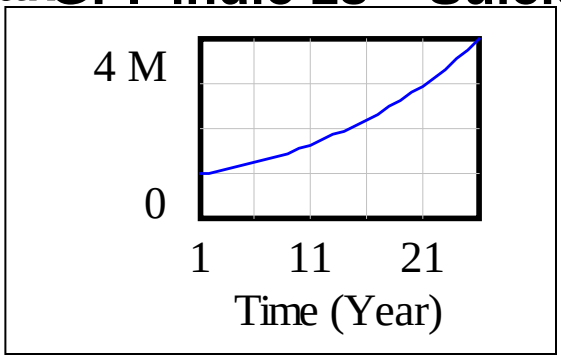


GPI (Social indicators)

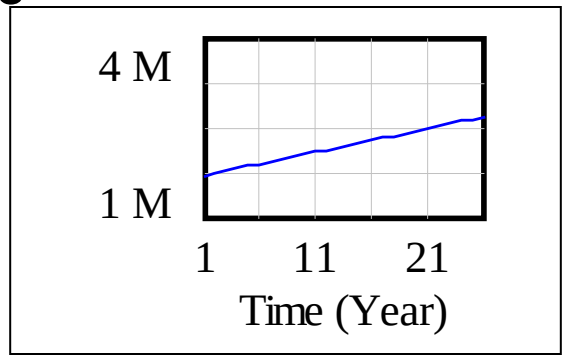
GPI indic 17 – Fam Break



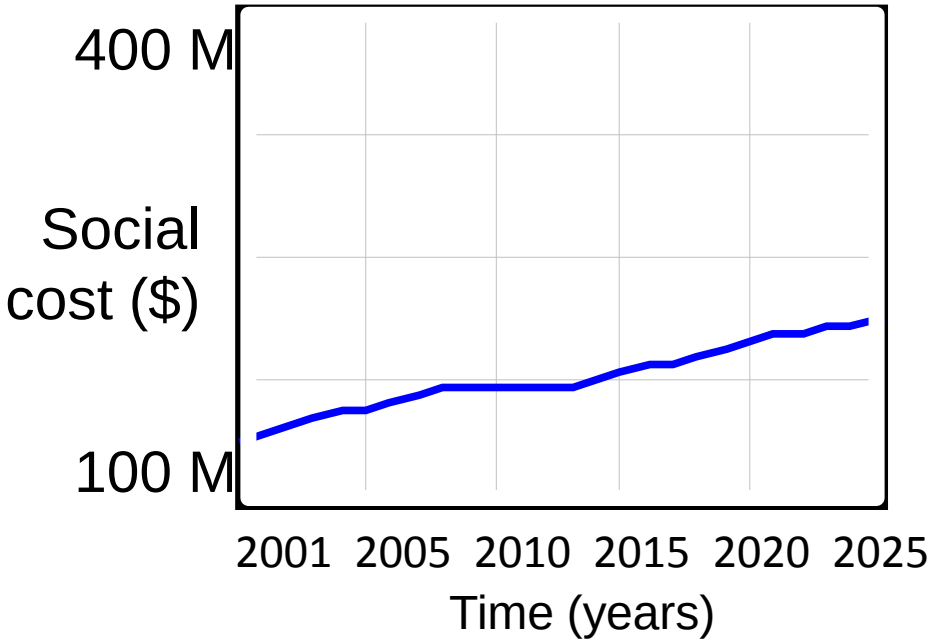
GPI indic 18 – Suicide



GPI indic 19 – Gambling



Social cost of growth



Conclusions

What development scenarios for the Motueka catchment

environment - economy - social system are sustainable?

Business-as-usual (sustainable?)

- Business-as-usual growth scenario is unlikely to achieve the development goals identified by the community reference group
- We have looked at indicators in the
  - Ecological sustainability area (tensions)
  - Social sustainability area (tensions)

  ≠ Economically sustainable (either)

Key problems

- Economic growth is also growing debt
- *Indirect + direct* GHG emission (offsets) will exceed available catchment land area
- Reason:
  - consumption (Indirect effects)
  - our focus on mitigation is direct effects (*i.e.* recycling, solar power, building insulation, hybrid cars etc), 5-10%
- Social costs of *business-as-usual* growth

Key problems

- GCP/GPI diverge long term
- We haven't considered offsetting:
  - water takes/discharges,
  - other point and non-point source pollutants,
  - landfill (solid waste streams) ,
  - non-renewable resources etc …

Conclusions

Building a sustainable scenario

Planning for a sustainable future

- If business-as-usual is not sustainable, then … what is?
- Question - how do we build a sustainable model scenario?
- Assume an ideal world
- On-the-ground implementation is another matter

To make a sustainable model run

- Manufacture, sell and buy local
  - Strategy for smart/local intermediate industry dev.
- Mitigation of direct effects (important) - yes
- Critical issues - reduce consumption (indirect effects)
- Substantial gains in energy efficiency and local *renewable* energy production
- Increase ecosystem service capacity (water discharges)

To make a sustainable model run

- **Innovation** associated with *sustainable* intermediate production and ecological restoration to offset *preferred* indirect consumption effects
- Reduction of fossil fuel transport (commuting)
- Demographic plans/policy needed
  - ageing population (labour market)
  - attract a local skilled workforce

Other important factors

- Sea-level change mitigation
- Managed net growth *(rather than net decline)* of threatened ecosystem services (& species) – *this implies offsetting should focus on indigenous ecosystem restoration (i.e. more land area)*

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www.natureonfilm.co.nz

How can cultural impacts of land use change be modelled?

Oscar Montes de Oca
Garth Harmsworth
Manaaki Whenua – Landcare Research

How can Agent Based Modelling be used for resource management?

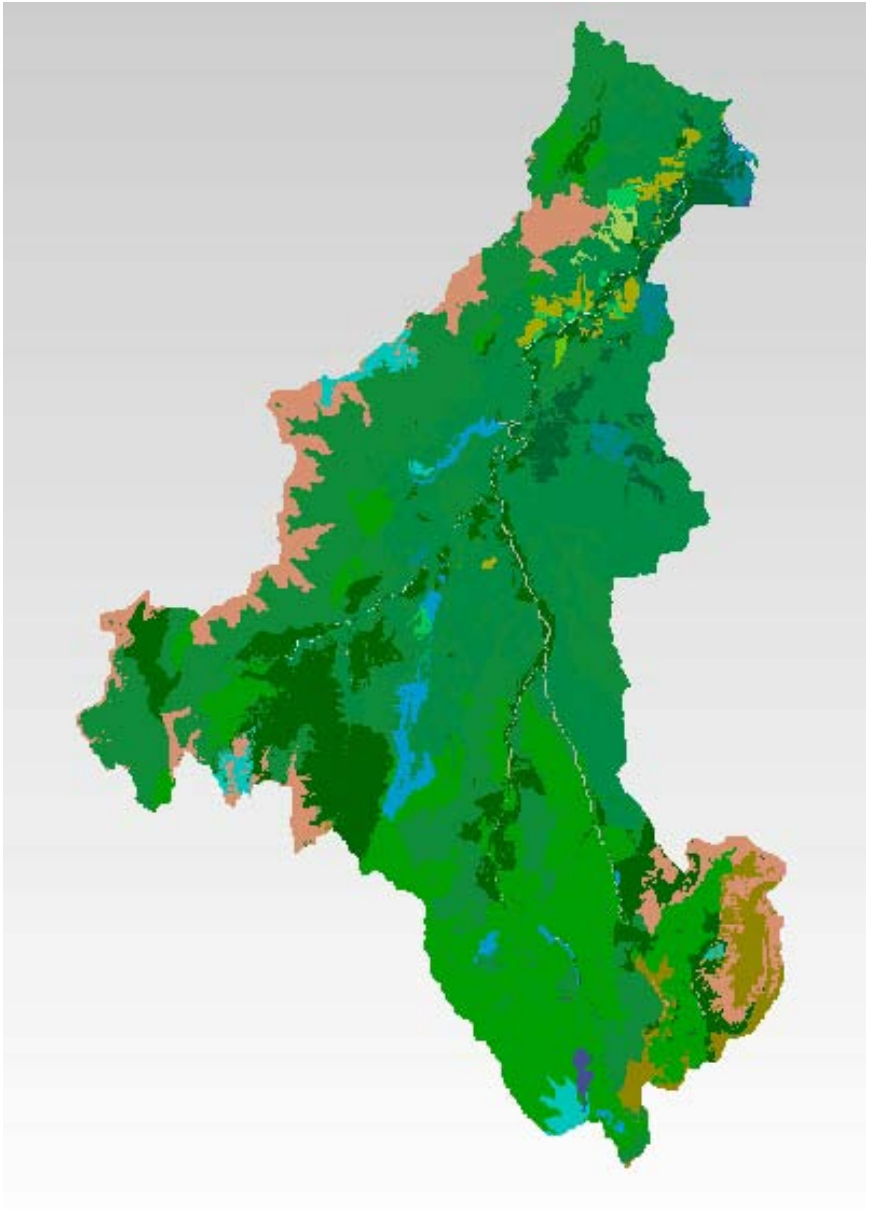
- Tool that helps with discussion on land use options
- Brings together:
  - "hard data" – gross margins, jobs, environment
  - "soft data" – aspirations, common goals
- Represents diversity of interests

Definition of a cultural metric for IDEAS

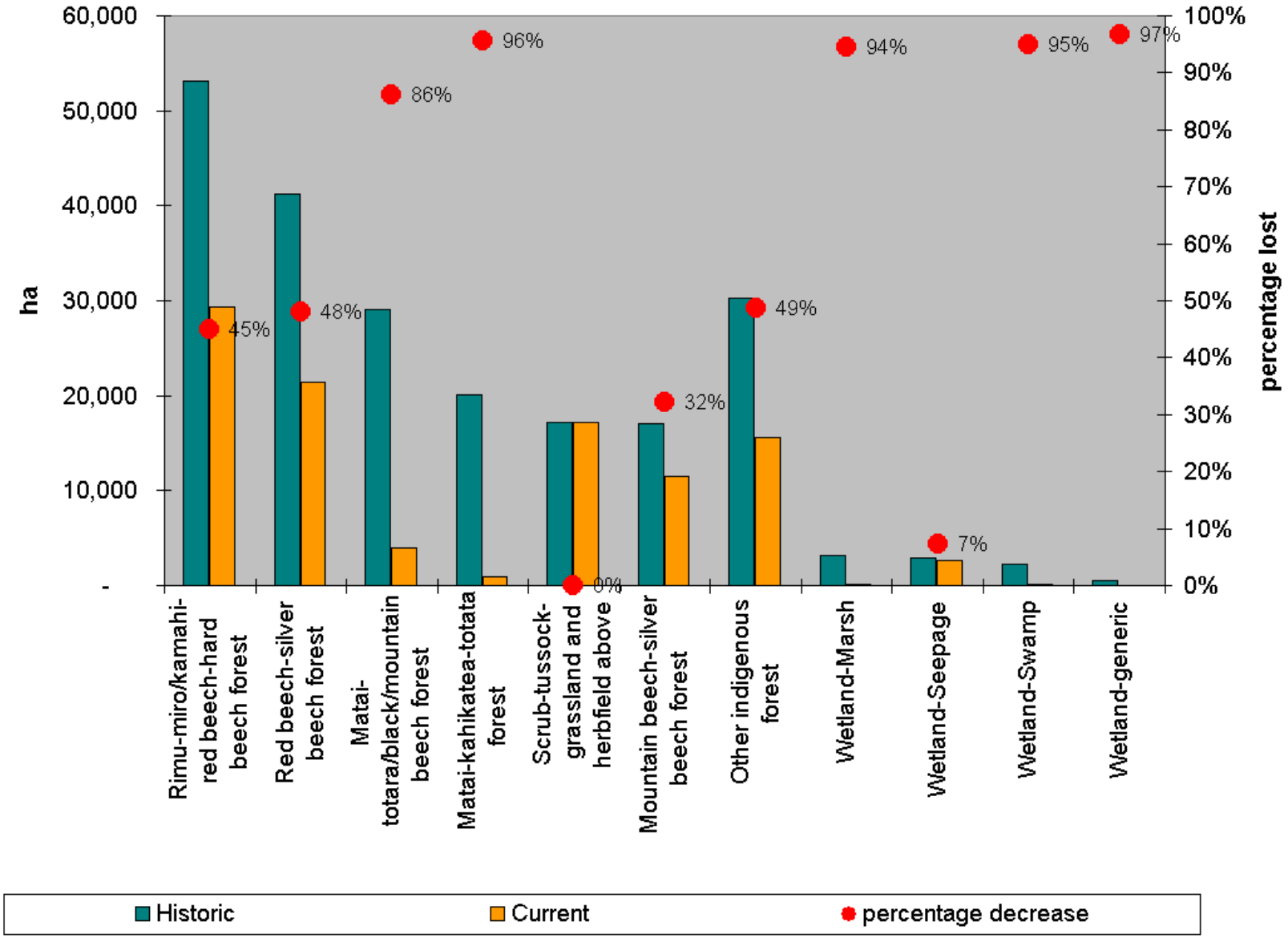
- Collaboration with Tiakina iwi group
- Visualisation was an effective trigger to discuss cultural values
- Integrated into the IDEAS framework

Pre-European cover to present cover to define original cultural values

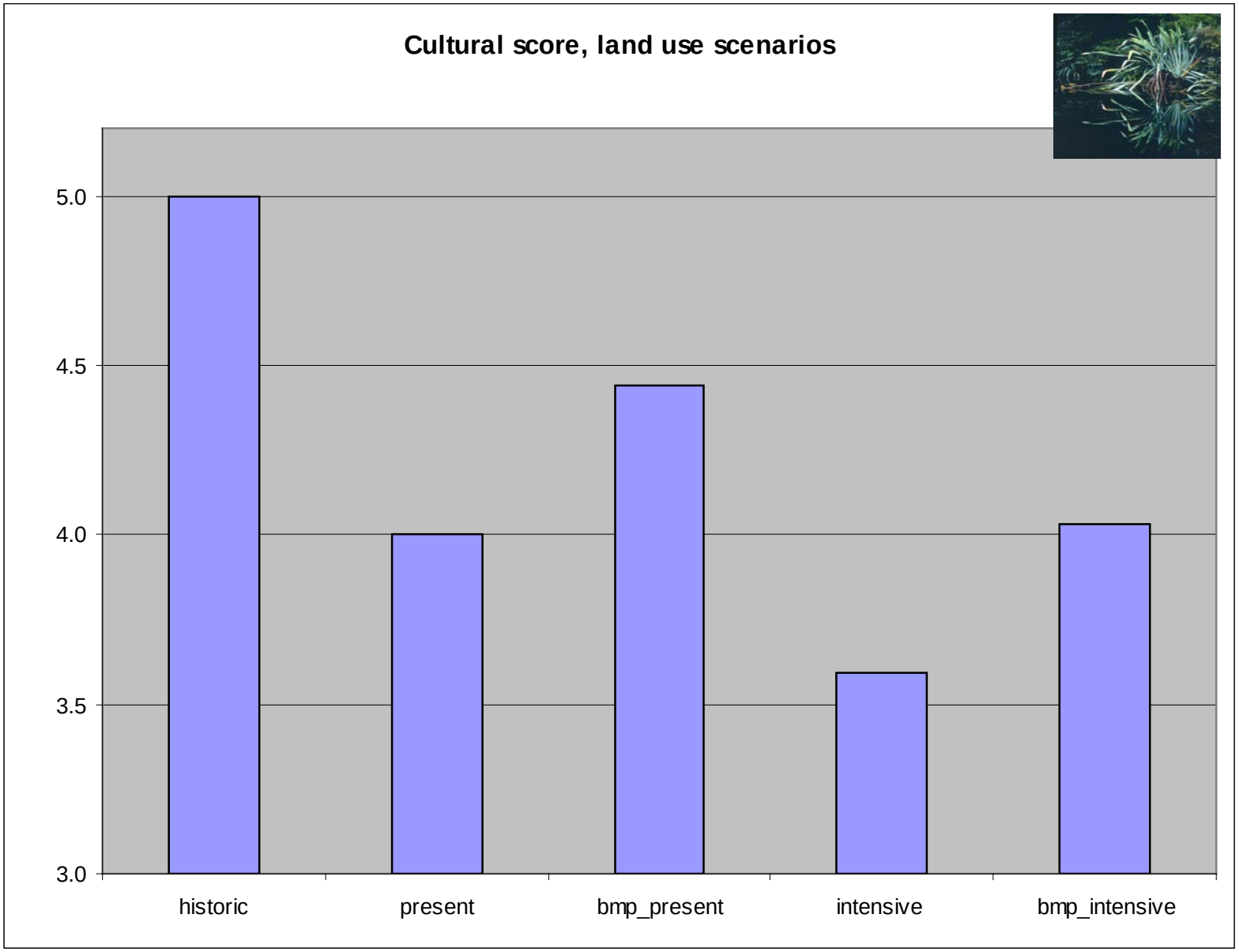
- Wetland-Seepage (45)
- Wetland-Marsh (44)
- Wetland-Swamp (43)
- Scrub-shrubland and tussock-grassland below treeline (42)
- Scrub-tussock-grassland and herbfield above treeline (41)
- Dunelands (39)
- Matai-totara/black/mountain beech forest (37)
- Mountain beech-silver beech forest (36)
- Red beech-silver beech forest (35)
- Silver beech forest (34)
- Rimu-miro-totara/kamahi forest (33)
- Rimu-matai-miro-totara/kamahi forest (32)
- Rimu-miro/tawari-red beech-kamahi-tawa forest (31)
- Rimu-miro/kamahi-red beech-hard beech forest (30)
- Matai-totara-kahikatea-rimu/broadleaf-fuchsia forest (28)
- Kahikatea-matai/tawa-mahoe forest (27)
- Matai-kahikatea-totata forest (26)
- Rimu/tawa-kamahi forest (25)



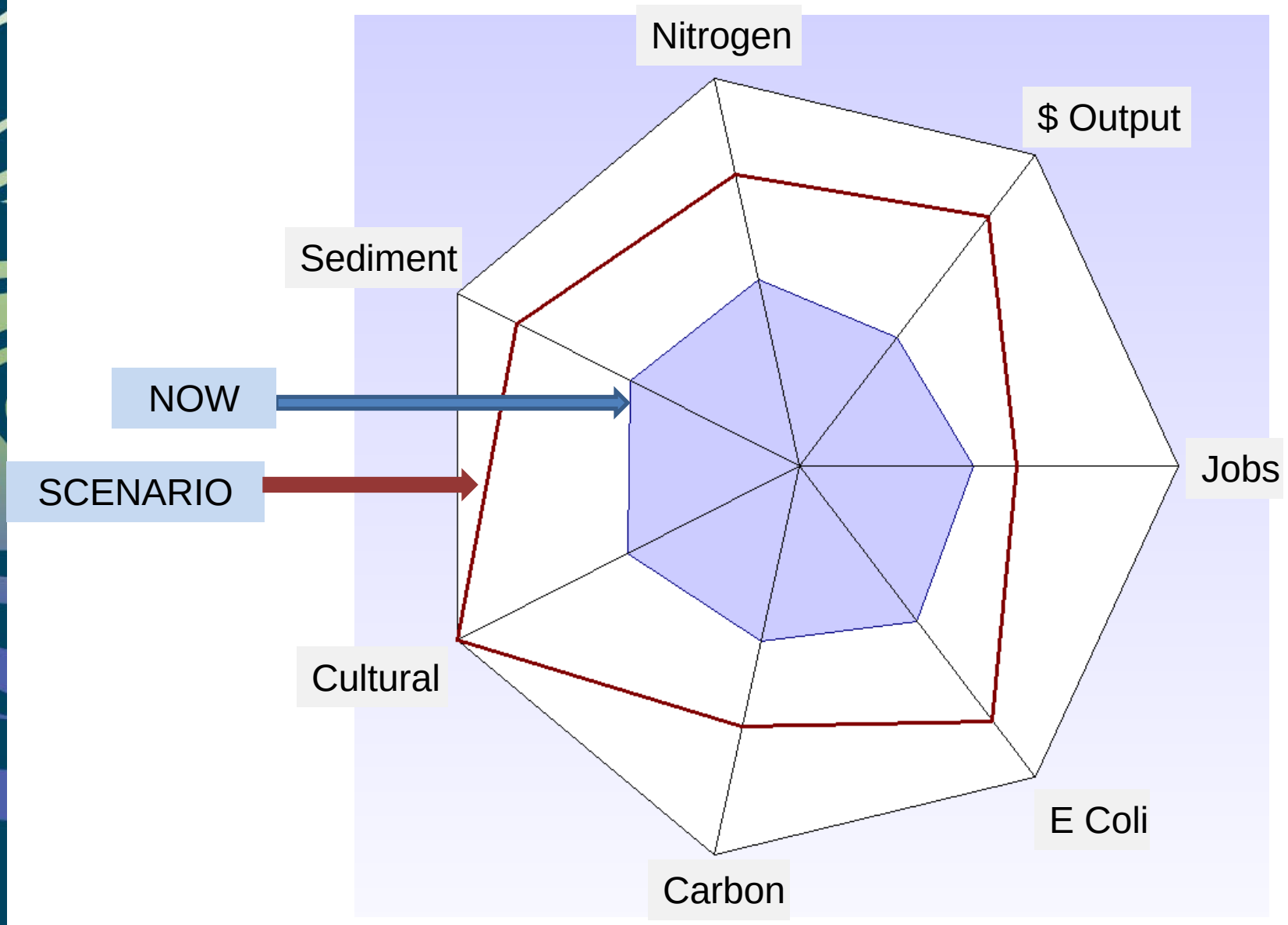
Forest and wetlands lost – cultural values impacted



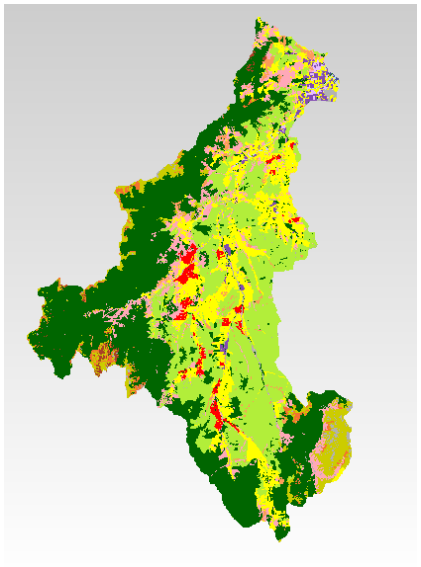
Cultural metric outcomes

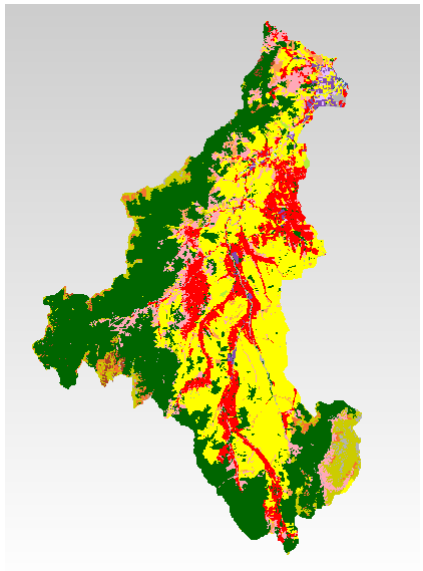


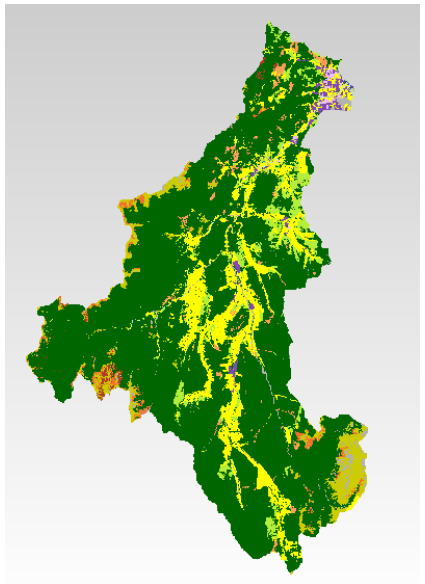
Trade off analysis –IDEAS indicators

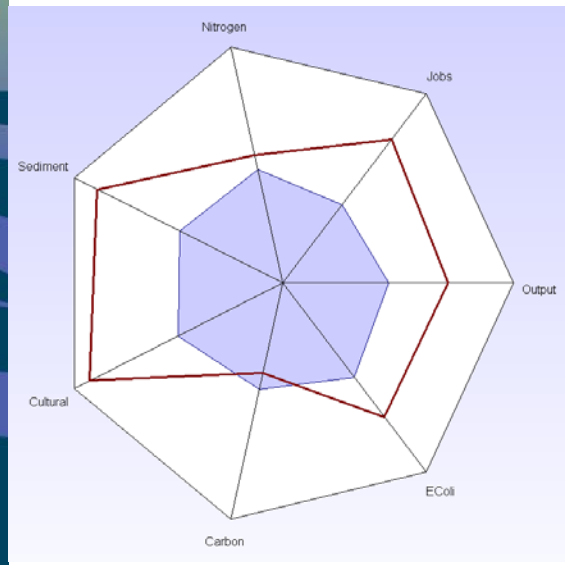


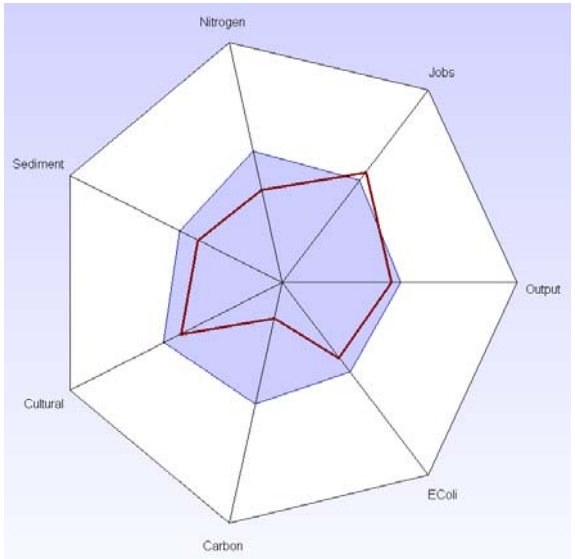
Trade off analysis for policy evaluation – quick prototyping

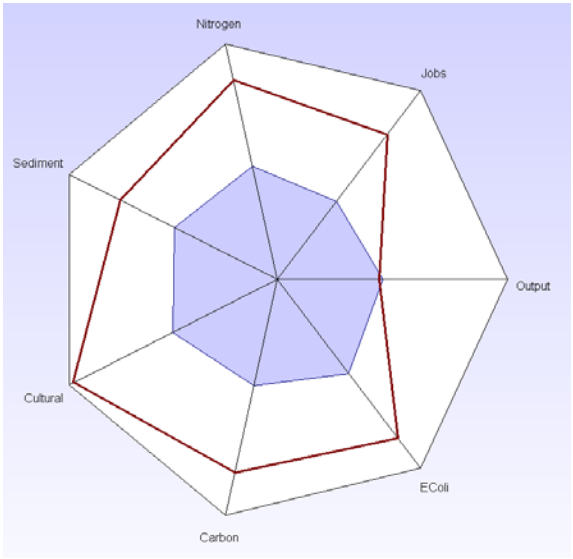












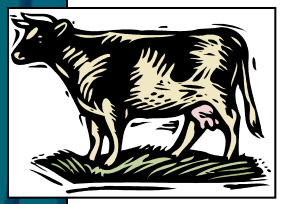
Land use and the marine environment

ICM IDEAS: using marine models to extend our assessment of land use decisions beyond the river mouth.

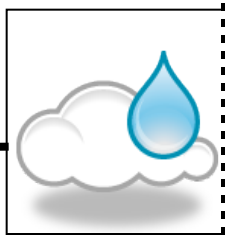
Why? Because size matters…

Catchment footprint on the coast can be large and persistent.

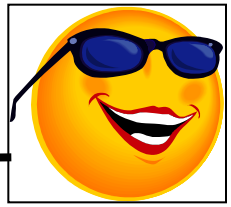
Connections

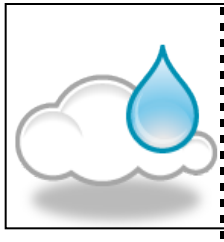


Catchment Model



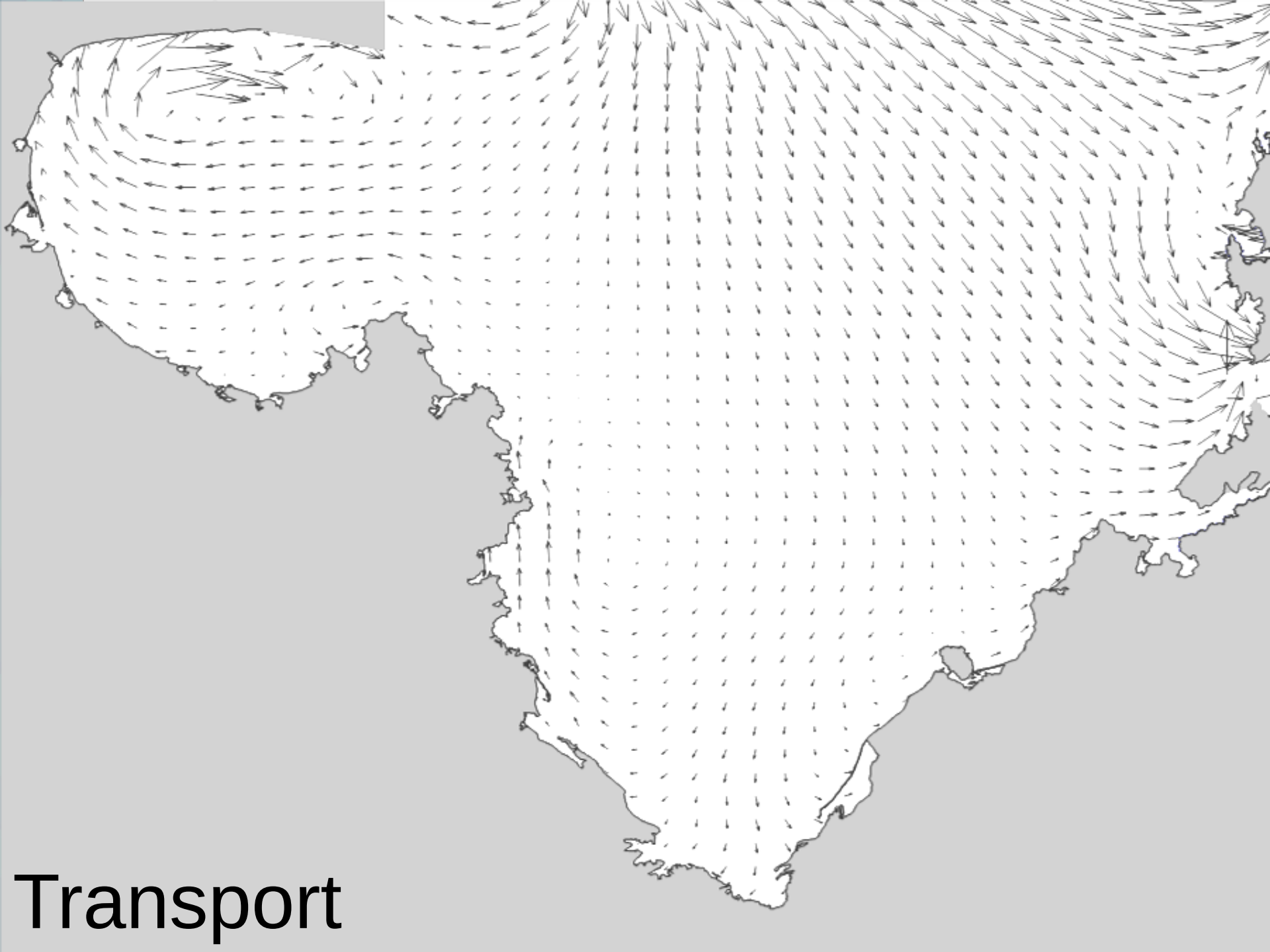
River Transport Model

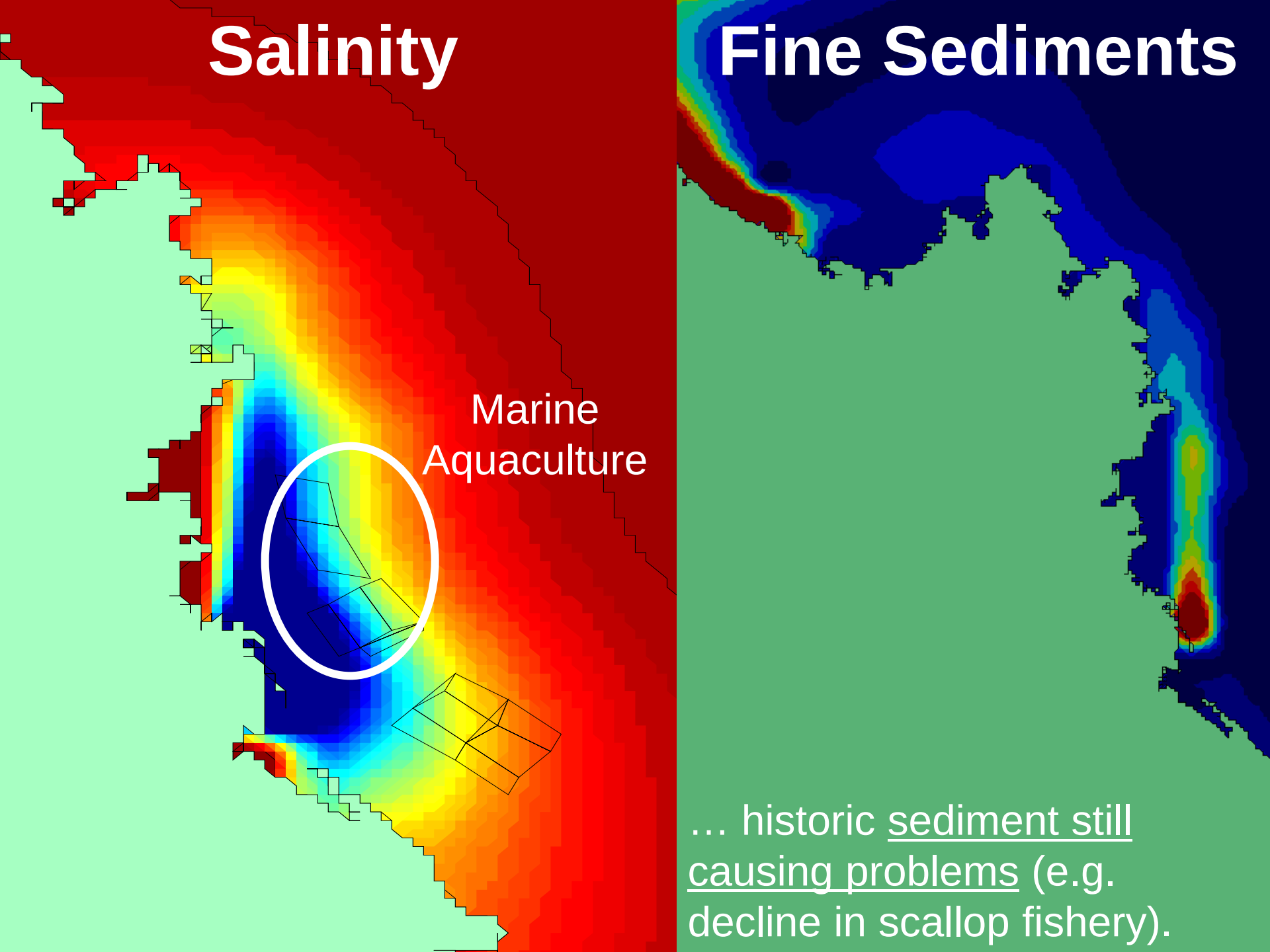




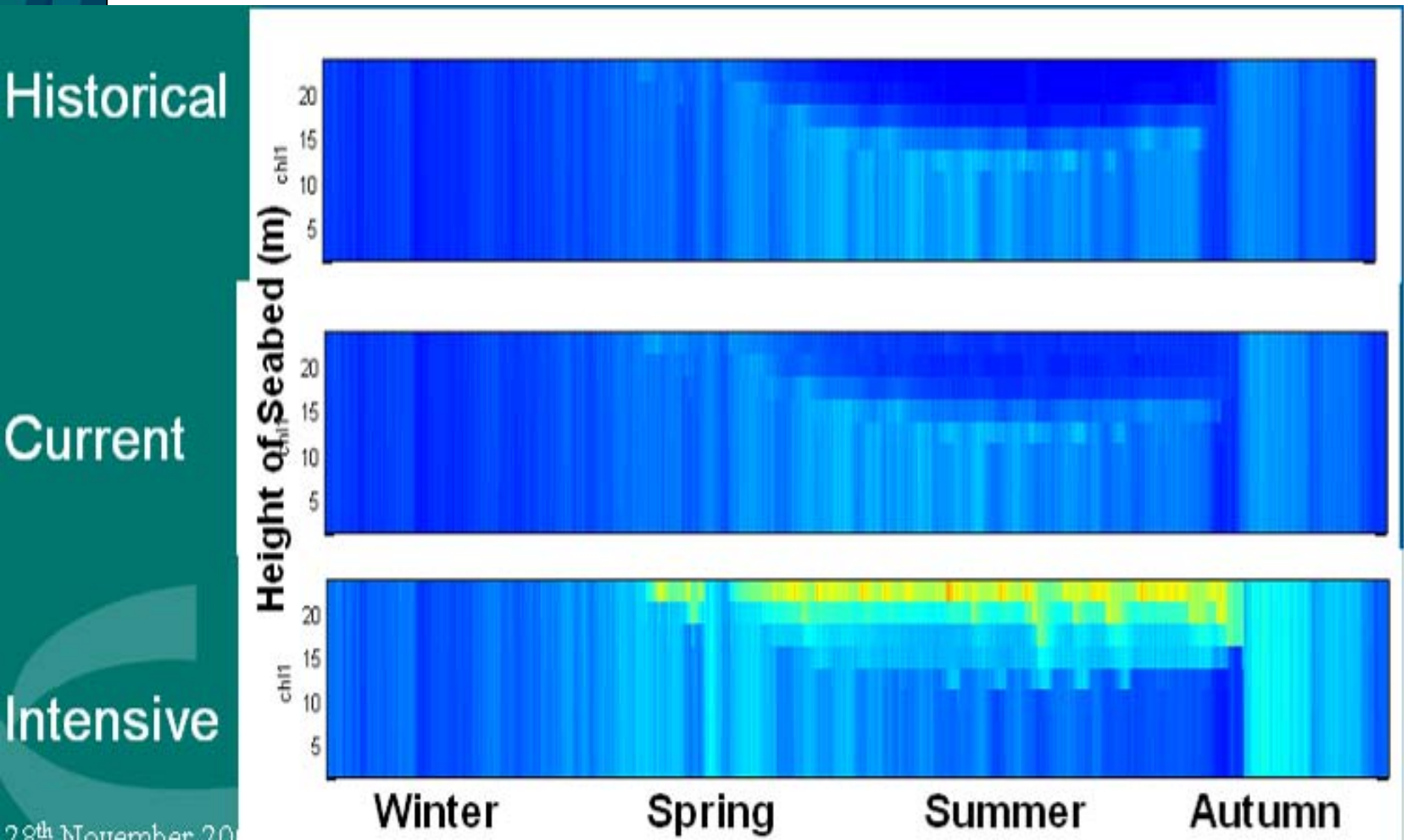
Water quality & quantity

Coastal Models


Transport

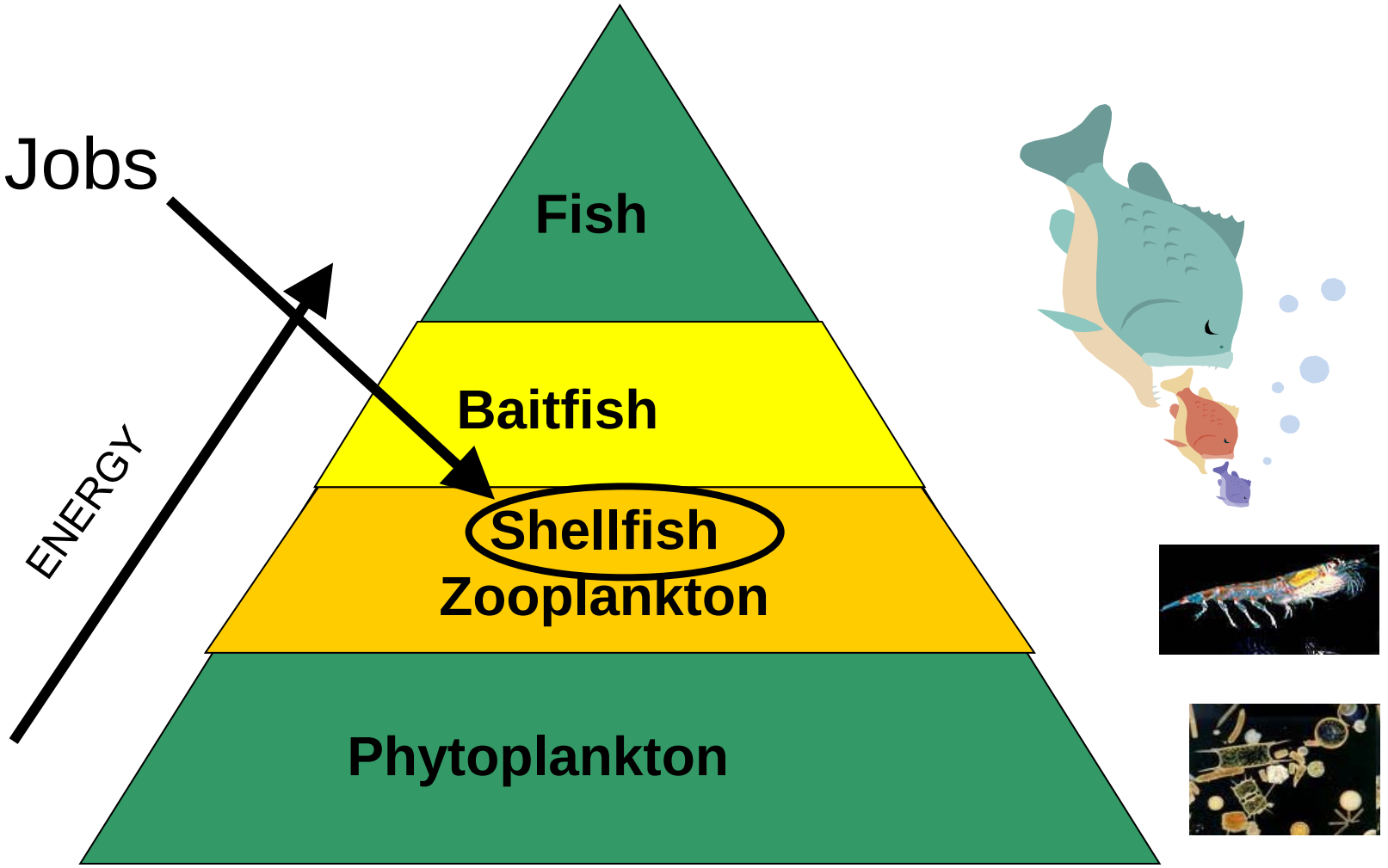

Salinity
Marine Aquaculture
Fine Sediments
… historic sediment still causing problems (e.g. decline in scallop fishery).

Nitrogen and phytoplankton.



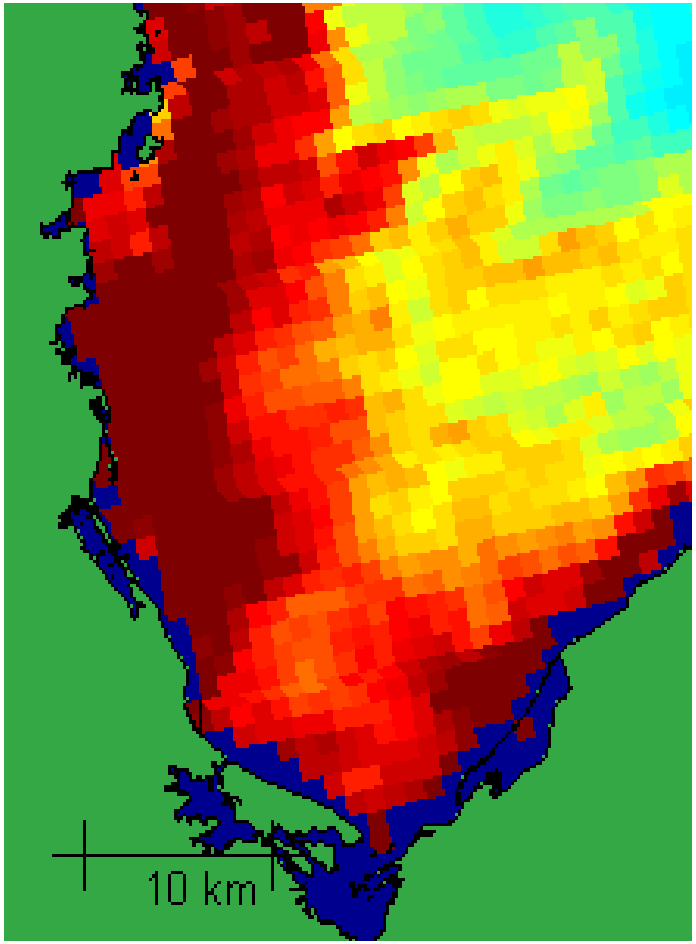
	Nitrogen Load (ton/yr)
Historical	234
Current	521
Intensive	3,806

Benefits for ecosystem/catchment economy?



Conclusions

- Land use can have positive and negative impacts on coast.
- Region and time of influence on coast can be large.
- Therefore need to consider coast in catchment decisions to avoid problems.
- IDEAS offers flexible approach to plan for the future.



Satellite image of turbidity (29 october, 2007). Red = high turbidity.