

# **Integrating socio-economic and land-use models to support urban and regional planning**

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# Research context

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- ◆ **Two research projects in New Zealand to develop and use spatial models for supporting planning processes**
  - policy impact assessment
  - exploring land-use developments
  - application to a rural region: Waikato
  - application to two urban regions: Auckland and Wellington





# Challenges

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- ◆ **Simulation of spatial developments over time**
  - Incorporation of a range of drivers
  - Dynamics driven by processes operating on various scales
  - Bottom-up and top-down interactions!
- ◆ **Development of a system for policy support**
  - Useful system for policy analysts in supporting scenario studies and policy impact assessment
  - Transparent system with access to data and parameters for technicians and modellers





## Starting point...

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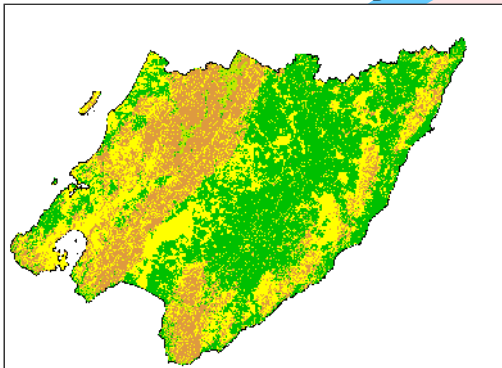
- ◆ **Metronamica land use model**
- ◆ **Constrained cellular automata based model**
- ◆ **Yearly time steps**
- ◆ **Time horizon 2025-2050**
- ◆ **Spatial extent 100 x 100 km (Wellington)**
- ◆ **Spatial resolution 100 m (Wellington)**



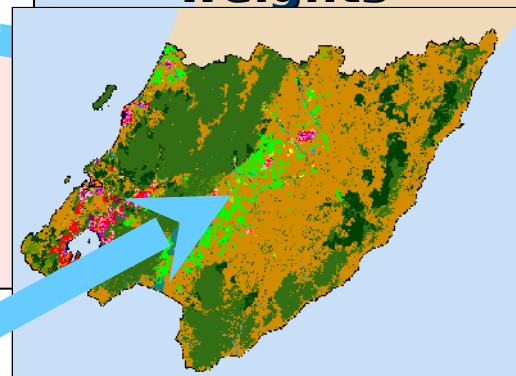
Stochastic  
perturbation

Land use  
at time T+1  
weights

Suitability



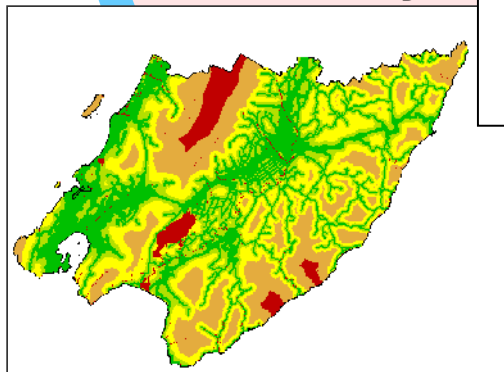
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Transition Rule

Change cells to the land use for which they have the highest transition potential until regional demands are met

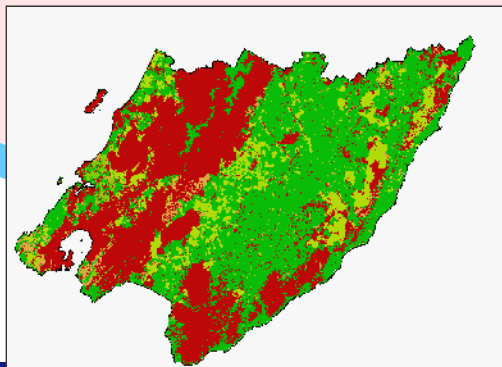
Accessibility



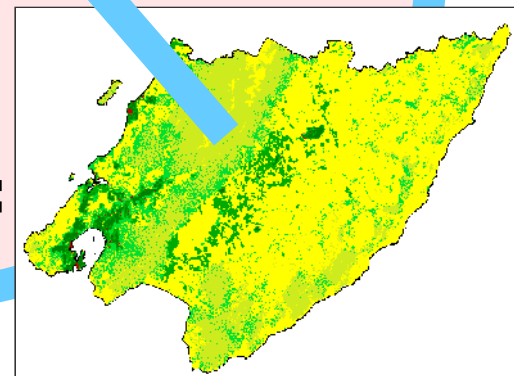
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Transition Potentials

Zoning



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# How to obtain regional demands?

## ◆ **Macro-economic model**

- Input-output model
- Calculation of economic developments per sector taking into account the interdependencies between sectors
- Annual time step

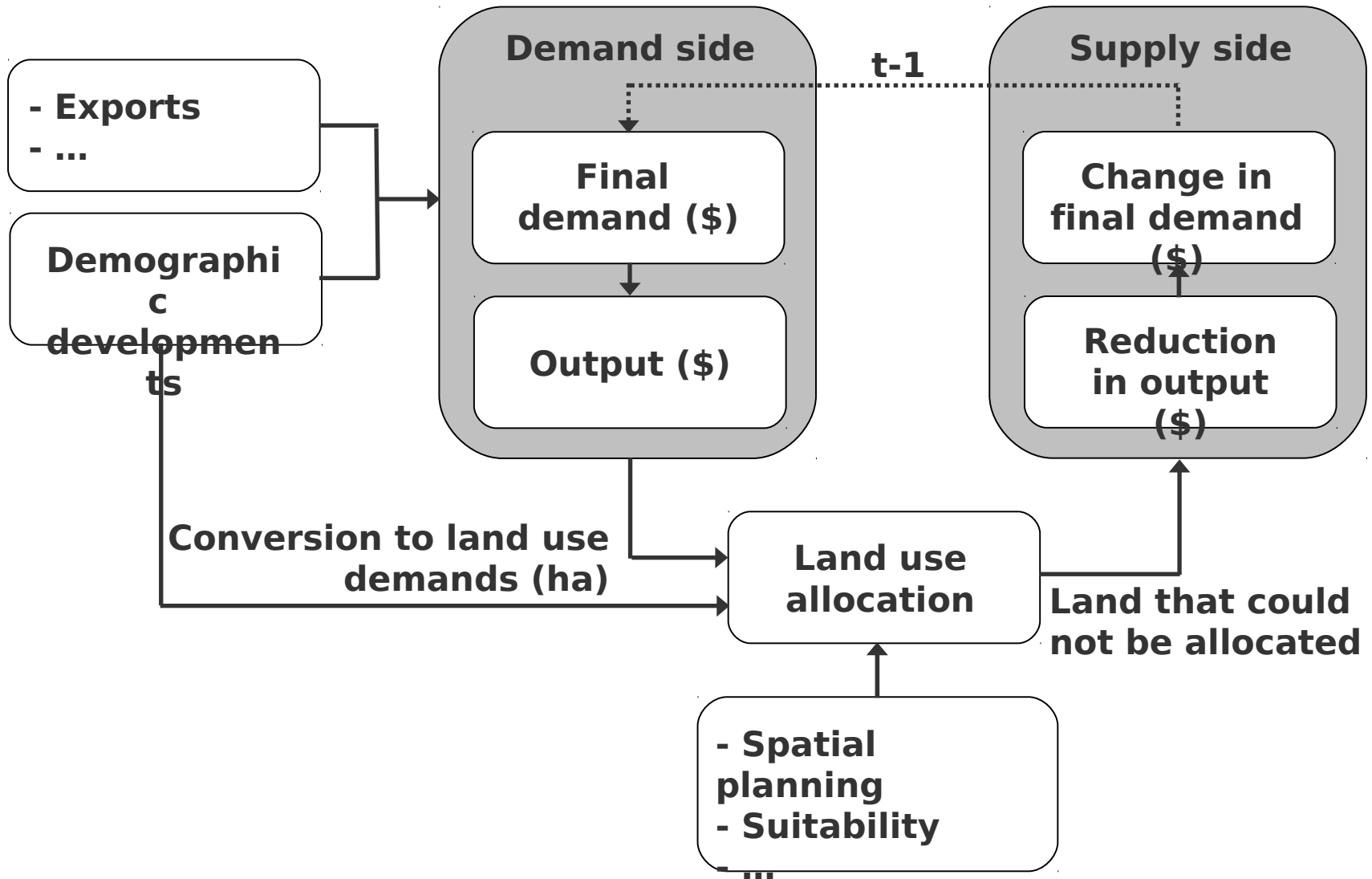
## ◆ **Demographic model**

- Age cohort model
- Calculation of the population per age cohort based on birth, mortality and migration rates
- Annual time step





# Integrating socio-economics and land use





# Two types of users

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- ◆ **GUI caters to 2 types of users**
  - **Modellers and scientists**
    - Access to all sub-models & underlying parameters
    - Organised through the system diagram
  - **Policy Users**
    - Only those variables influenced by policy are available
    - Grouped logically to ease construction of scenarios, running simulations, and visualising, exploring & comparing outputs





Main window

Drivers

External factors

Policy measures

Parameters

Scenarios

Indicators

Analysis

Economy

Sector: Horticulture and fruit growing

International exports: min\$ (2004)

Interregional exports: min\$ (2004)

Gross fixed capital formation: min\$ (2004)

Changes in inventories: min\$ (2004)

Population

Fertility lever:

Mortality lever:

Additional net in-m

District / Time

Franklin

Thames-Corom

Hauraki

Waikato

Matamata-Piako

Land use map

- Bare Surfaces
- Indigenous Vegetation
- Other Exotic Vegetation
- Wetland
- Residential - Lifestyle Blocks
- Residential - Low Density
- Residential - Medium to High
- Commercial
- Community Services
- Horticulture
- Biofuel Cropping
- Vegetable Cropping
- Other Cropping
- Dairy Farming
- Sheep, Beef or Deer Farming
- Other Agriculture
- Forestry

District boundaries

Land use map

LayerManager

Zoom tools

Named viewports:

Grid tools

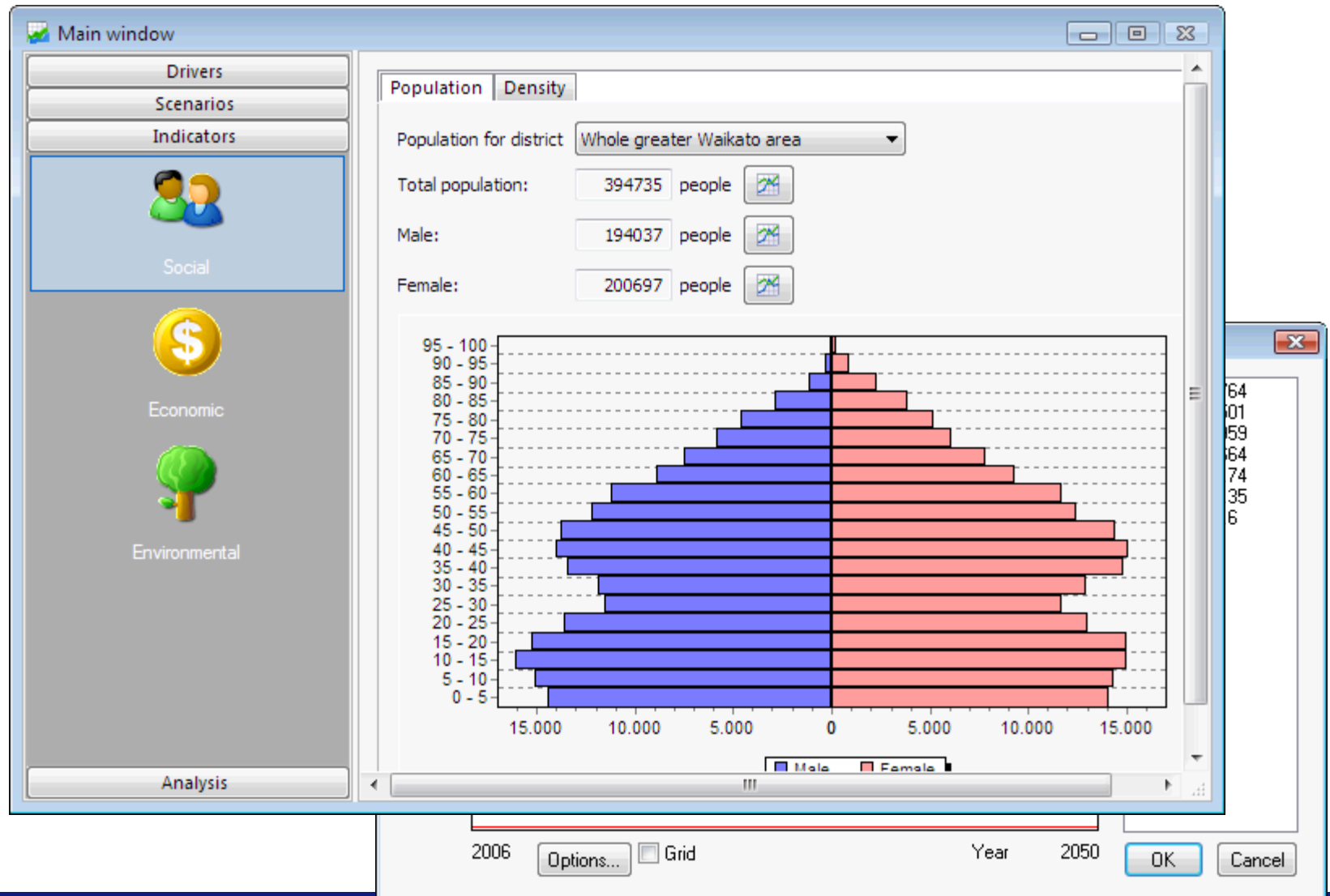
Pen

Flood

www.ri



# User interface: Policies and scenarios

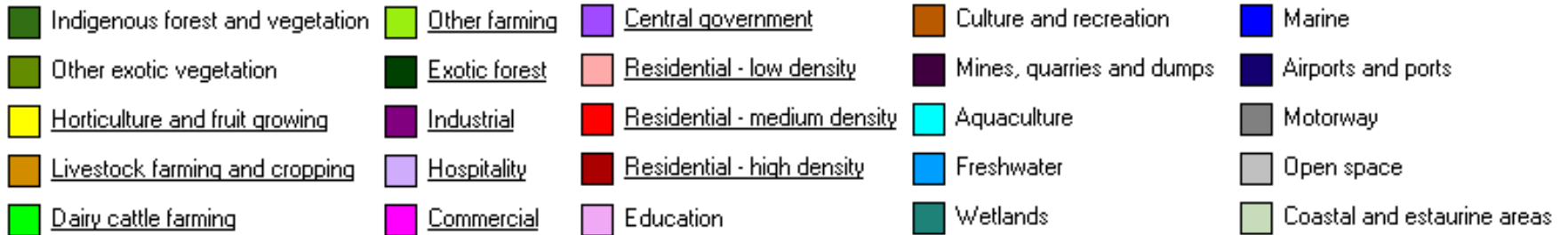
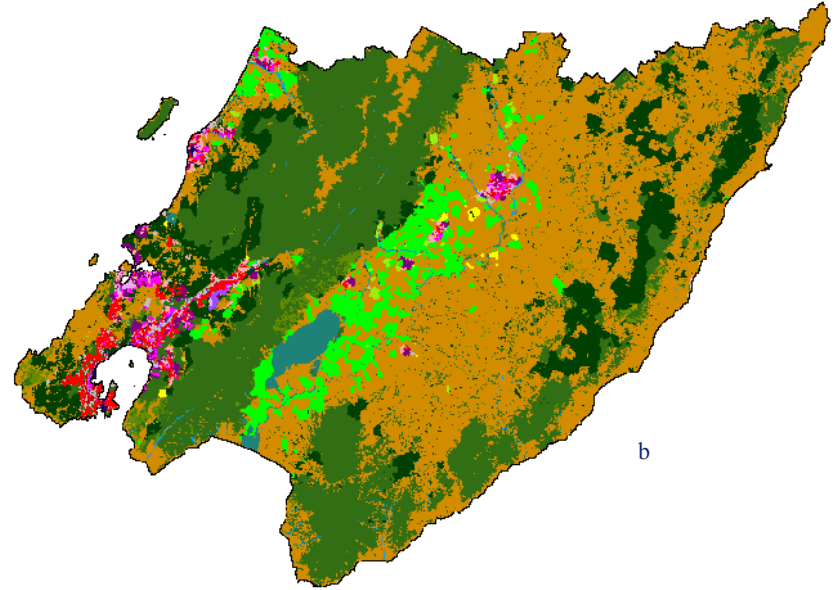
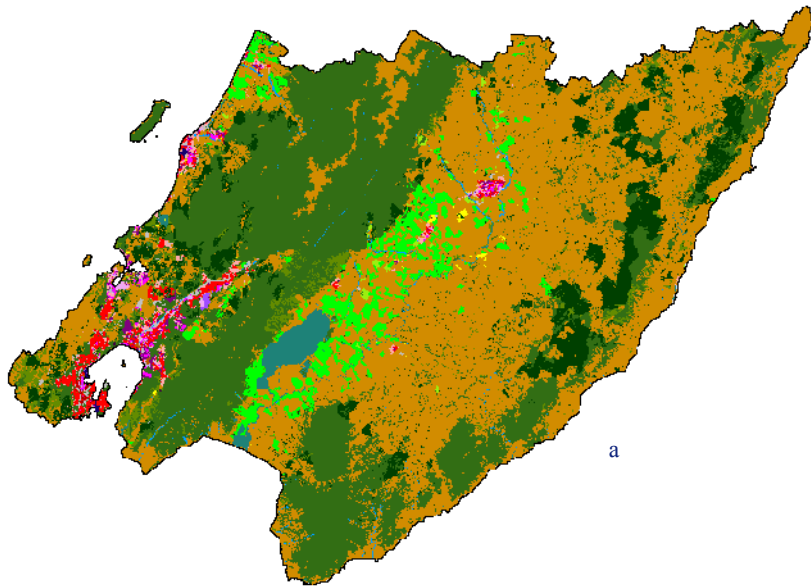




# Results: Land use maps

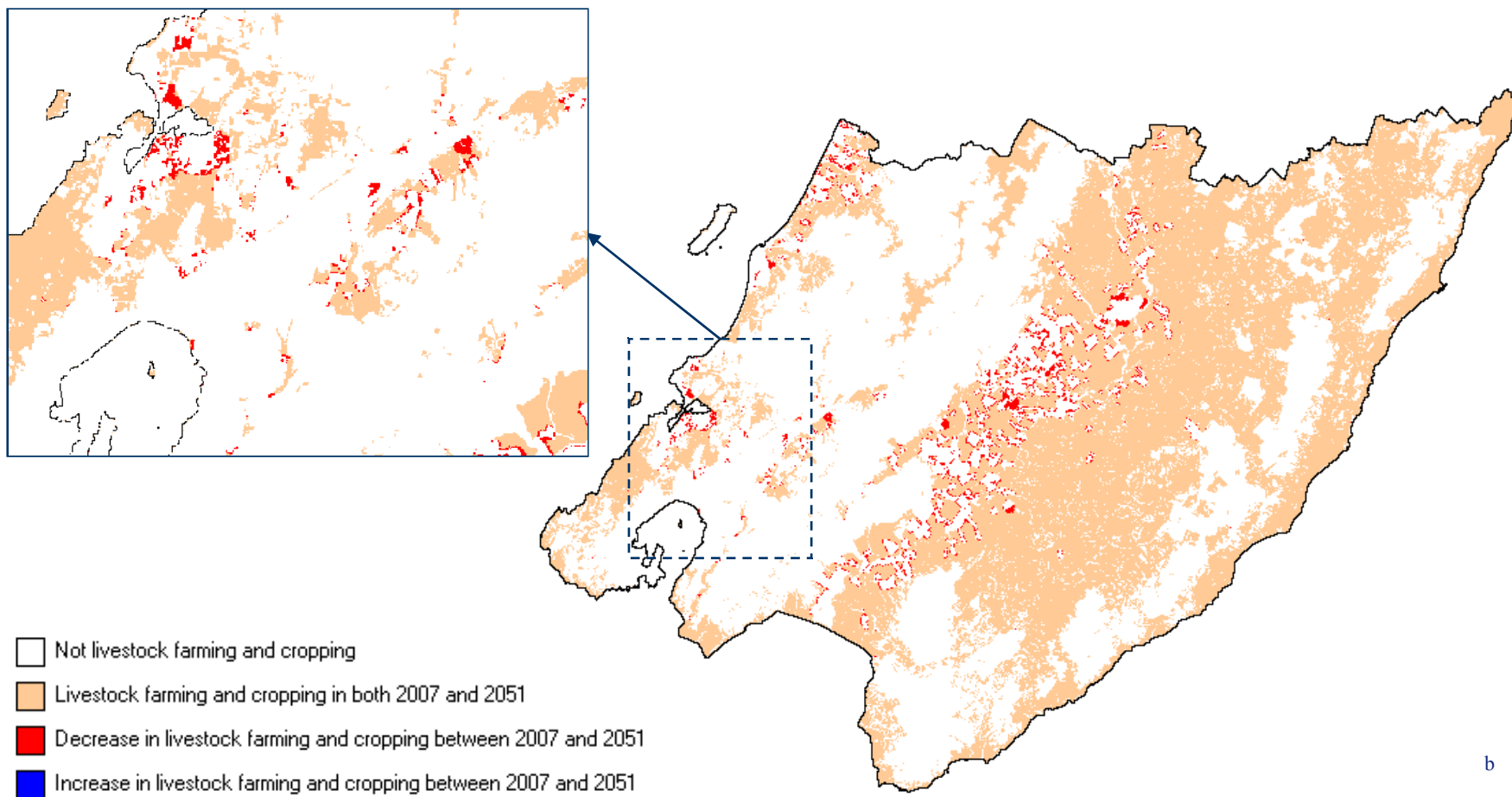
2007

2051



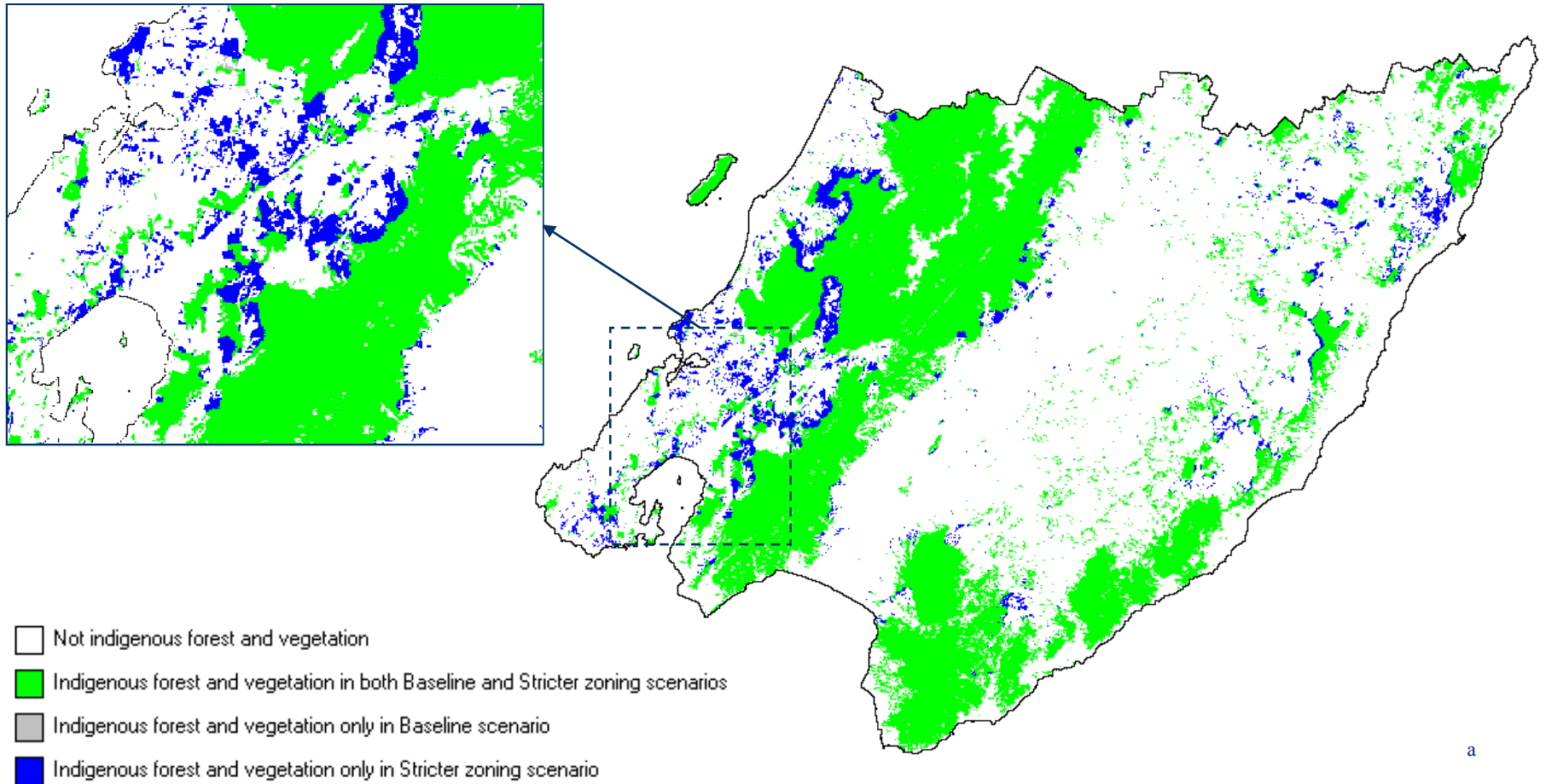


# Results: change in livestock farming





# Results: difference between scenarios





# Results: economic impact

Scenarios → Results from the economic model ↓	2007	Baseline 2051	No constrains 2051	Strict zoning 2051
Total economic output (mln \$2004)	37604	64872	64897	64837
Output in Livestock and cropping farming in 2051 (mln \$2004)	184	189	208	188
Output in Meat and meat product manufacturing in 2051 (mln \$2004)	278	413	417	413
Overall economic growth over the period 2007-2051 (%)		72.51	72.58	72.42
Growth in Livestock and cropping farming over the period 2007-2051 (%)		2.44	12.63	1.77
Growth in meat and meat product manufacturing over the period 2007-2051 (%)		48.55	49.83	48.41



# Conclusions on the modelling approach

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- ◆ **Equilibrium approach of economic models often poses conceptual conflicts with the simulation approach of dynamic land use change models**
- ◆ **Being able to couple models technically doesn't mean the coupling makes sense!**
- ◆ **For future research it is recommended to focus first on the integration of the processes and next on the model implementation**





## **Conclusions on the policy support**

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- ◆ **Dual user interface valued by users**
- ◆ **Uptake of the system is facilitated by frequent user interaction throughout the entire developments process**
- ◆ **Large number of practical exercises with users and modellers**
- ◆ **Training and implementation**







**Thank you!**

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