

ABSTRACT AND PRESENTATION



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The Australian National University

Day 2, 1.50pm

Area of work: Integrated assessment

Specialty: Bringing good science to decision-making through developing innovative, enduring and adaptive processes, tools and techniques.

Take-home messages:

1. When dealing with landscape-scale processes, qualitative and quantitative knowledge from a variety of sources needs to be systematically incorporated into a single decision-support tool to assist catchment managers and other investors.
2. Bayesian Networks are sufficiently flexible to allow incorporation of different types of knowledge and the participation of end-users, and probabilistic in nature, meaning they can incorporate the uncertainty inherent in large-scale processes with long time lags.
3. These features are likely to be important if decision support systems are to be adopted and widely used.

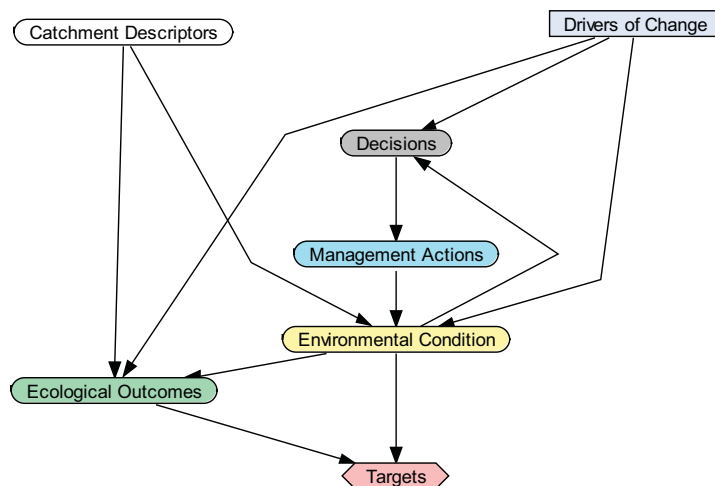
Relevant publications

- Ticehurst JL, Pollino CA (2007) Build Models or Capacity? Comparison of Techniques for Building Bayesian Networks for the Natural Resource Management Regions of Australia. MODSIM 2007, Christchurch, New Zealand.
- Pollino CA, White A and Hart BT (2007) Development and application of a Bayesian decision support tool to assist in the management of an endangered species. *Ecological Modelling* 201, 37-59.
- Pollino CA, Woodberry O, Nicholson AE, Korb KB and Hart BT (2007) Parameterisation of a Bayesian network for use in ecological risk management. *Environmental Modelling & Software* 22, 1140-1152.
- Tighe MK, Pollino CA, Cuddy SM, Whitfield S. (2007) Climate Change Pressures on Natural Resource Management in the Central West of NSW; 2007; MODSIM 2007 Christchurch, New Zealand.
- Hart BT, Pollino CA (2008) Increased Use of Bayesian Network Models Will Improve Ecological Risk Assessments. *Human and Ecological Risk Assessment* 14, 851-853.

Integration tools for decision-making

The aim of Landscape Logic is to link the management of land and water to natural resource condition across landscapes. Achieving this aim is a complex interdisciplinary task, requiring input from a range of fields including social science, ecology, mathematical modelling and natural resource management. The best available knowledge we have from these disciplines can range from 'gut feel' to a detailed process-based understanding. To integrate these different forms of knowledge across disciplines we need flexible integration tools that can (a) structure knowledge and (b) represent information in a usable and adaptive form for natural resource managers. In Landscape Logic we are seeking to do this by using Bayesian Networks (BNs). BNs are ideal for: structuring management and assessment objectives; enabling participation of users in model building; targeting evidence collection; and aiding inclusion of good science into decision-making. BNs are being used to explore system interactions (e.g. investment decisions → on-ground activities → processes/impacts → resource condition outcomes), while capturing the uncertainties in this knowledge. Our experiences with BNs suggest they are an accessible and intuitive modelling approach that allows researchers and decision-makers to document knowledge and interrogate system interactions within an adaptive framework.

To communicate and interact with the integration models, as well as house the new knowledge and information generated from Landscape Logic, we are constructing a Decision Support System (DSS). The Landscape Logic DSS will act as a warehouse of information, containing maps, facts sheets, and a range of interactive tools, including integration models. The DSS will be built using a philosophy of adaptive decision support, allowing information to be updated and adapted as we gain new system knowledge. In order to achieve the goals of integration in the Landscape Logic program, the integration team has three inter-linked themes: capacity-building, model-building and development of decision support systems. The integration team within Landscape Logic is building capacity within its research teams as well as natural resource management bodies to establish a skill base and encourage adoption of decision support tools. Model-building activities are targeted at Landscape Logic research projects which are forming the basis of the DSS. The development of the DSS is being lead by an integration team, in consultation with Landscape Logic projects and partners. The Landscape Logic DSS will be completed by July 2010.





LANDSCAPE LOGIC



Developing Integration Tools for Decision-Making

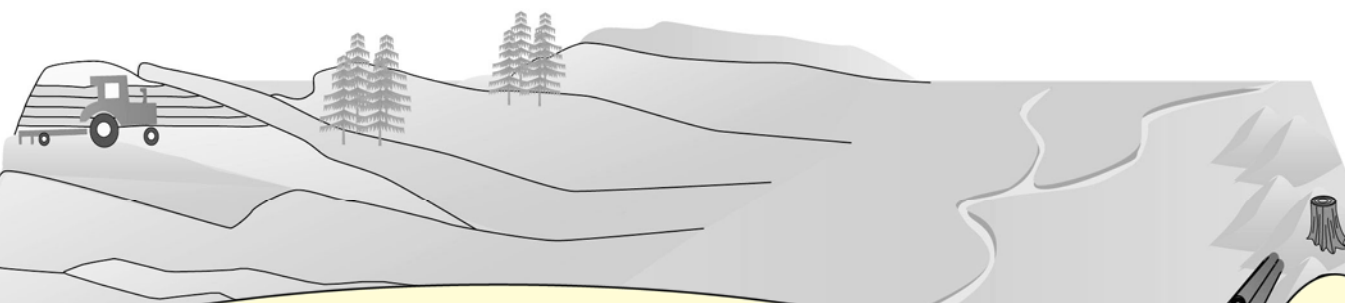
Carmel Pollino
Jenifer Ticehurst
Wendy Merritt
Tony Jakeman

A partnership between North Central, North East and Goulburn Broken CMAs, NRM North, South and Cradle Coast, UTAS, ANU, CSU, RMIT University, CSIRO, Forestry Tasmania, Victorian Dept. of Sustainability and Environment, and the Tasmanian Department of Primary Industries and Water.



LANDSCAPE LOGIC
LINKING LAND AND WATER MANAGEMENT TO RESOURCE CONDITION TARGETS

1. Can we find better ways to organise knowledge to support decision making?
Knowledge Integration
2. Can we shed light on ecological and social processes? – (response functions)
Knowledge Discovery
3. Communication and training
Knowledge Brokering



Knowledge Integration

Tony Jakeman
Carmel Pollino

Victorian CMA's

Tas NRM regions

Knowledge Broking

Greg Pinkard

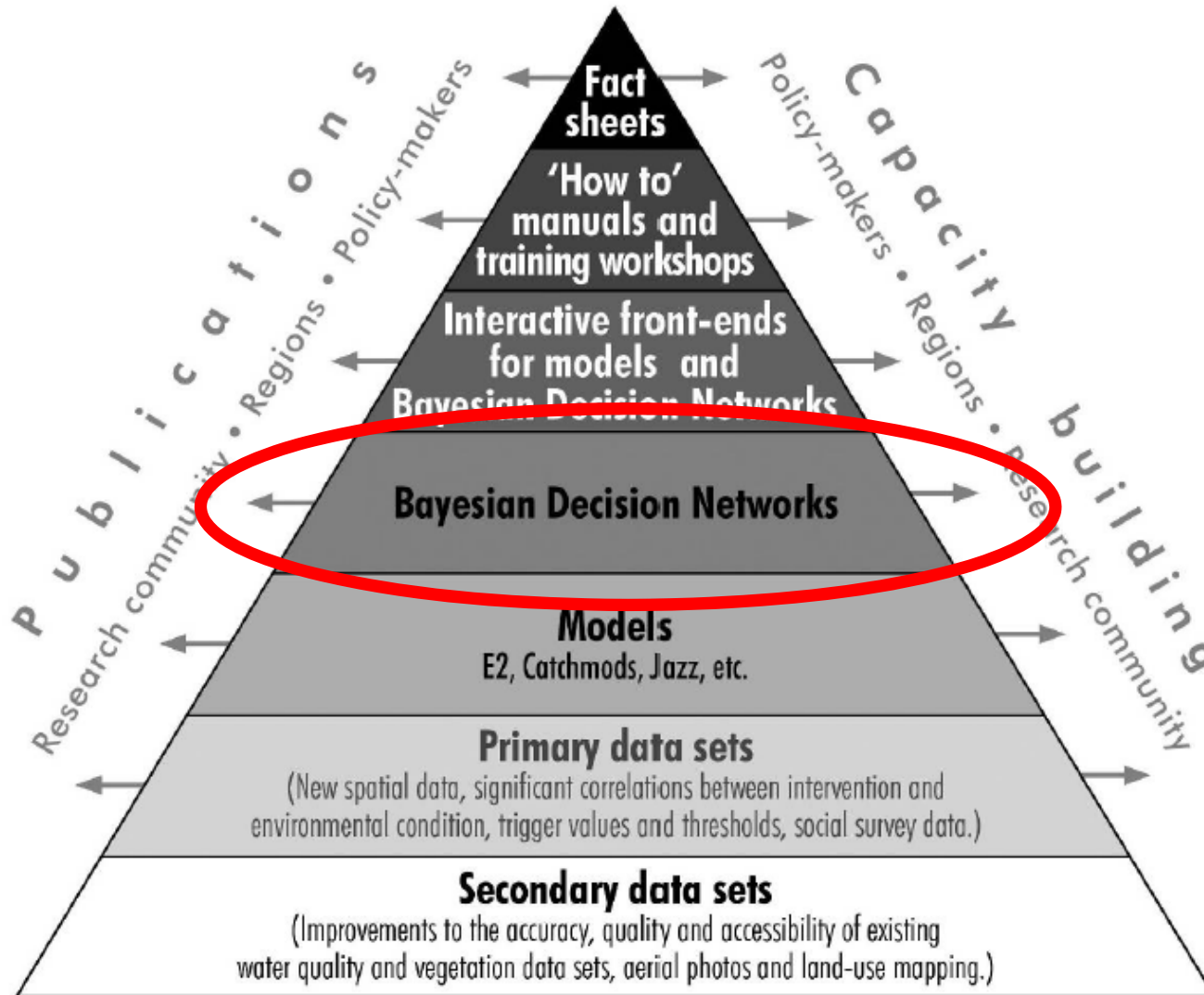
Knowledge Discovery

Water quality
Cresswell
Broad
Davies
Gibson
Newham

Spatial
Norton
Jones
Social
Curtis

Vegetation Condition
Duncan

Outputs from Landscape Logic



Integration: Bayesian Networks

Develop an integrating framework to

1. Establish links between management and resource condition using Decision (Bayesian) networks
2. Evaluate the effectiveness of past NRM interventions on resource condition
3. Using 1 and 2, develop tools to improve effectiveness of NRM investments

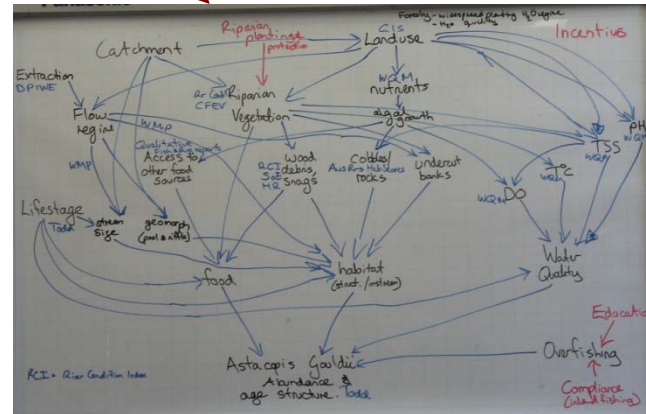
The Real World

Building Bayesian Networks

(All models are wrong, but some are useful [Box, 1976])

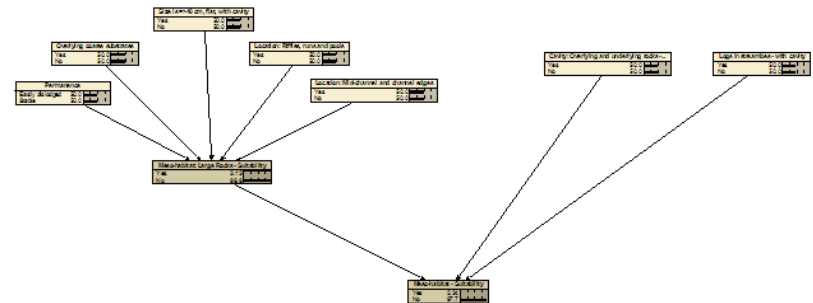


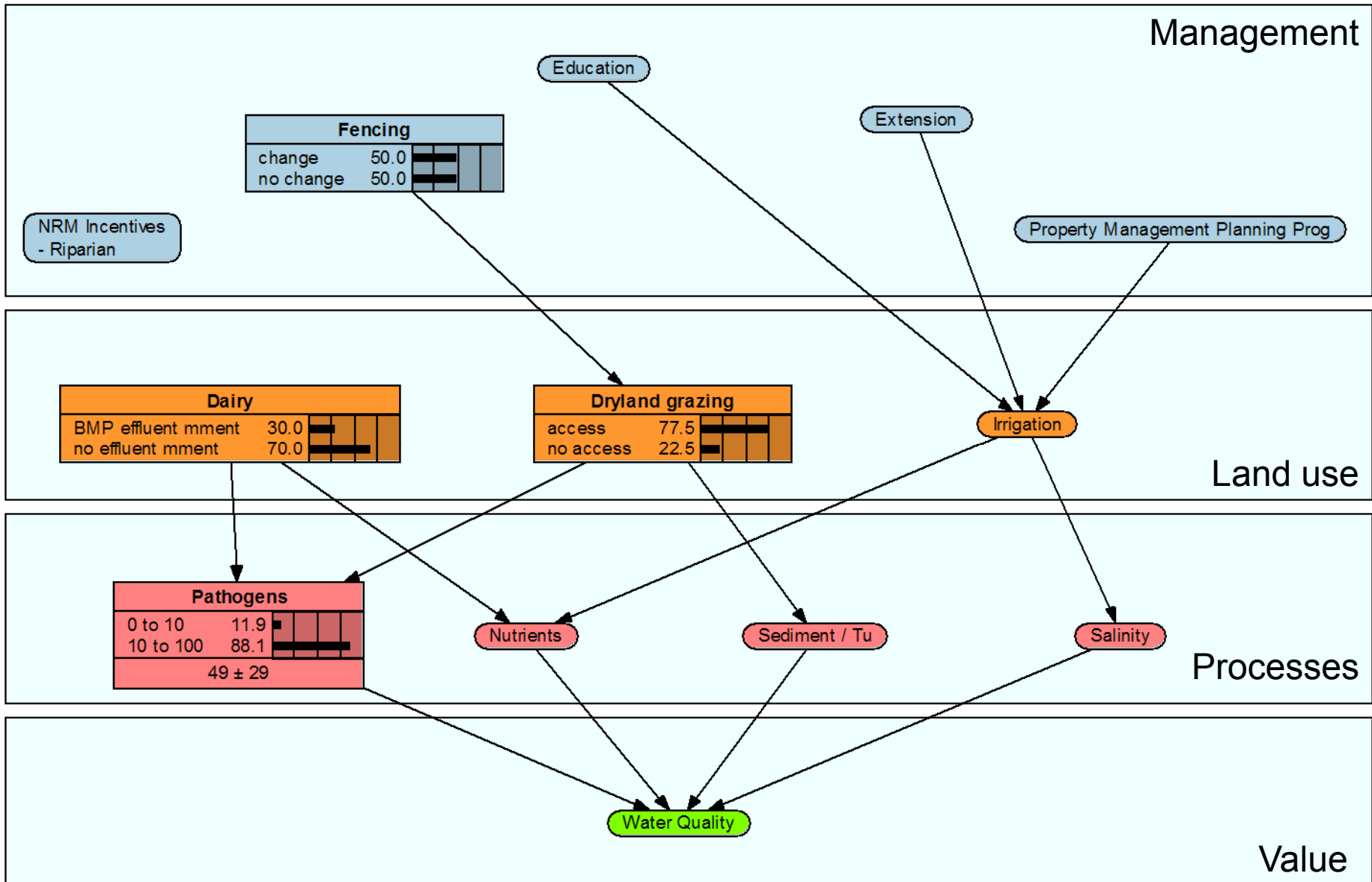
Astacopsis gouldi



Conceptual Model: Influence Diagram

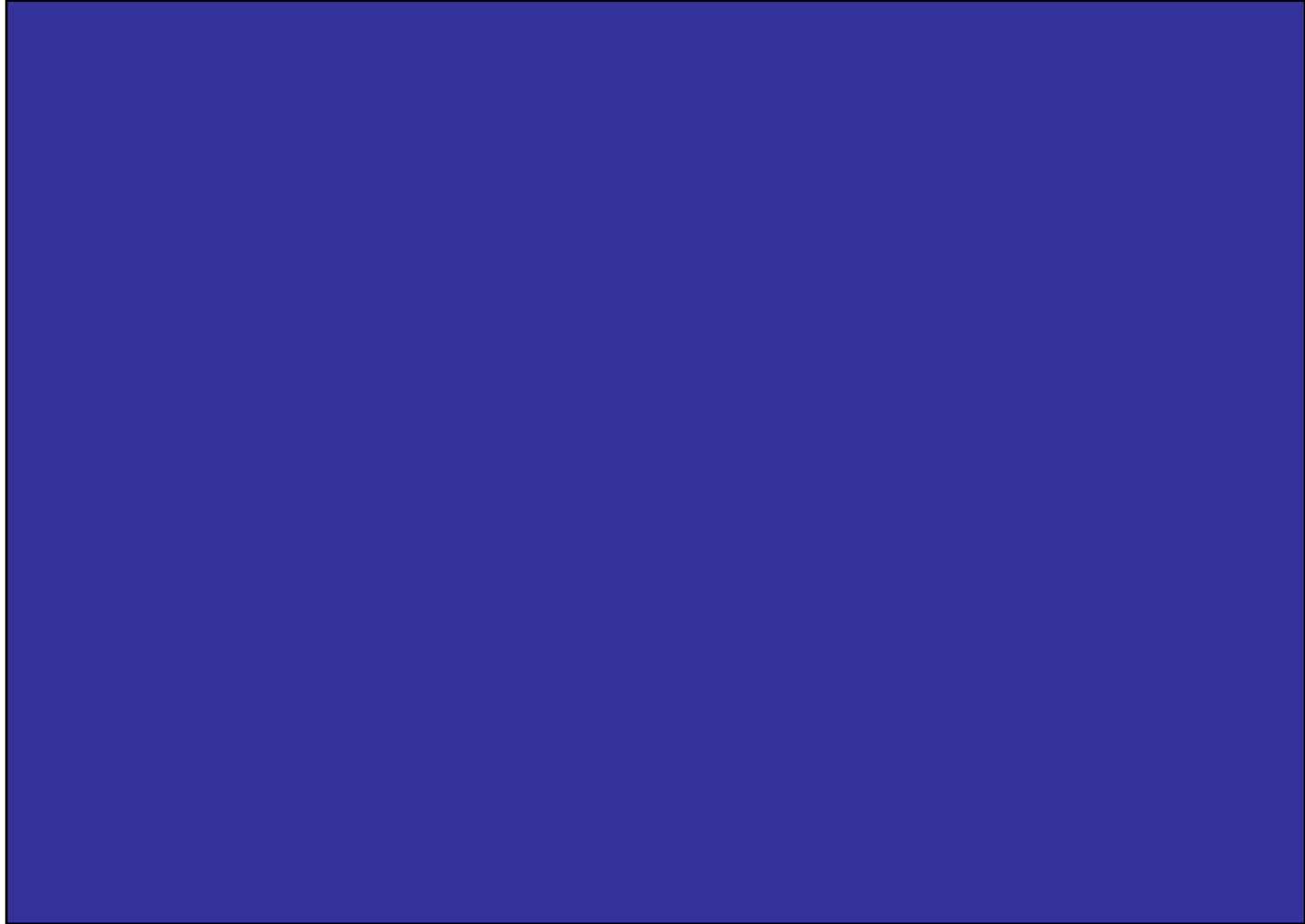
Bayesian network:
Probabilities using expert and data inputs



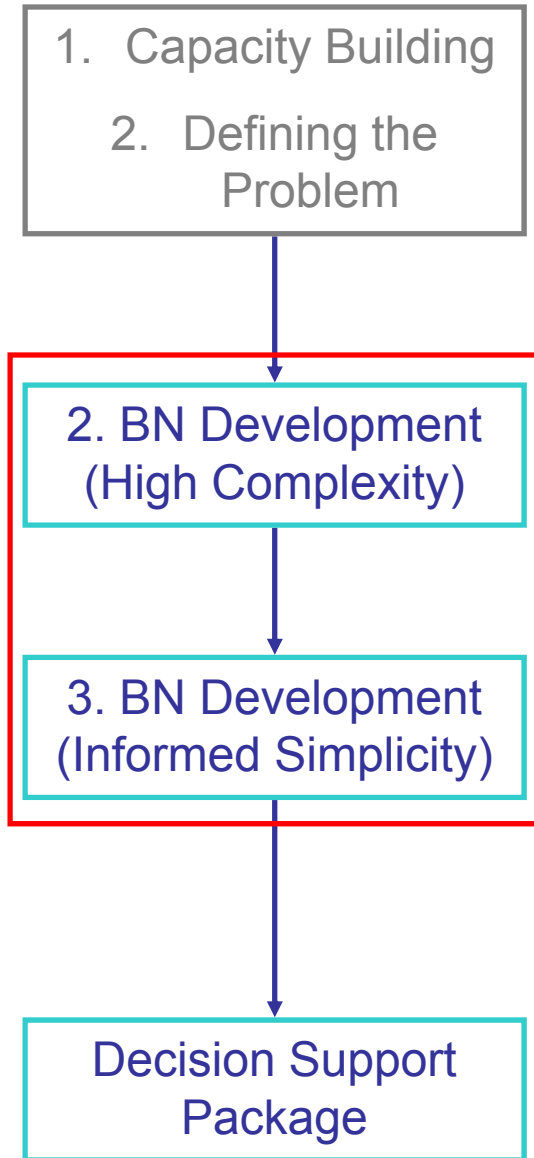


Hierarchy: Linking Management to Resource Condition using a BN

Natural Resource Management



Integration: Benefits



- Engagement
- Focus of project and project team
- Building an evidence base
- Interrogating the evidence base
- Delivering practical, useable and relevant outcomes
- Improved adoption of tools

CMO-based frameworks

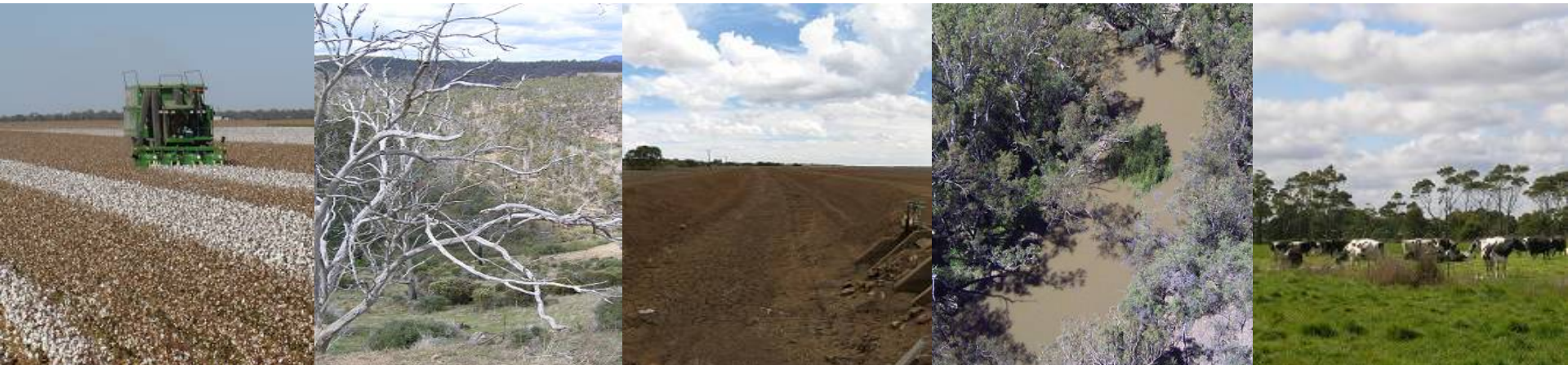
CAPACITY BUILDING

3 NRMs (Tas) & 3 CMAs (Vic)

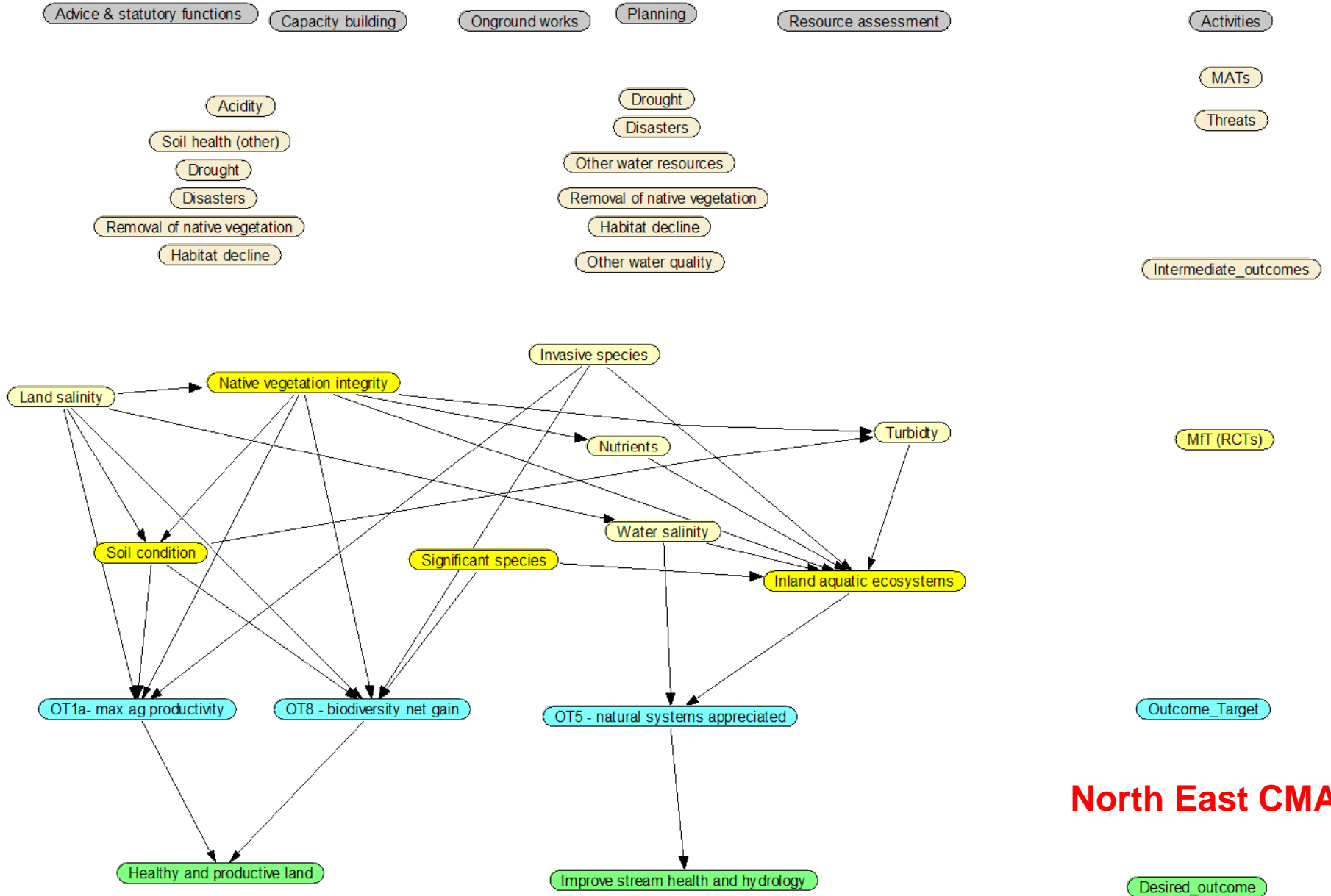
13 workshops with CMO staff

Buy-in: Fitting BNs into existing activities

- Capacity Building: CMO skills in BN building
 - Program Logic
 - Structure influence diagram
 - Matters for Target
 - Documentation of assumptions of current understandings
 - Monitoring, Evaluation and Reporting
 - What to monitor?
 - Evaluating outcomes
 - Potential: Reporting tool

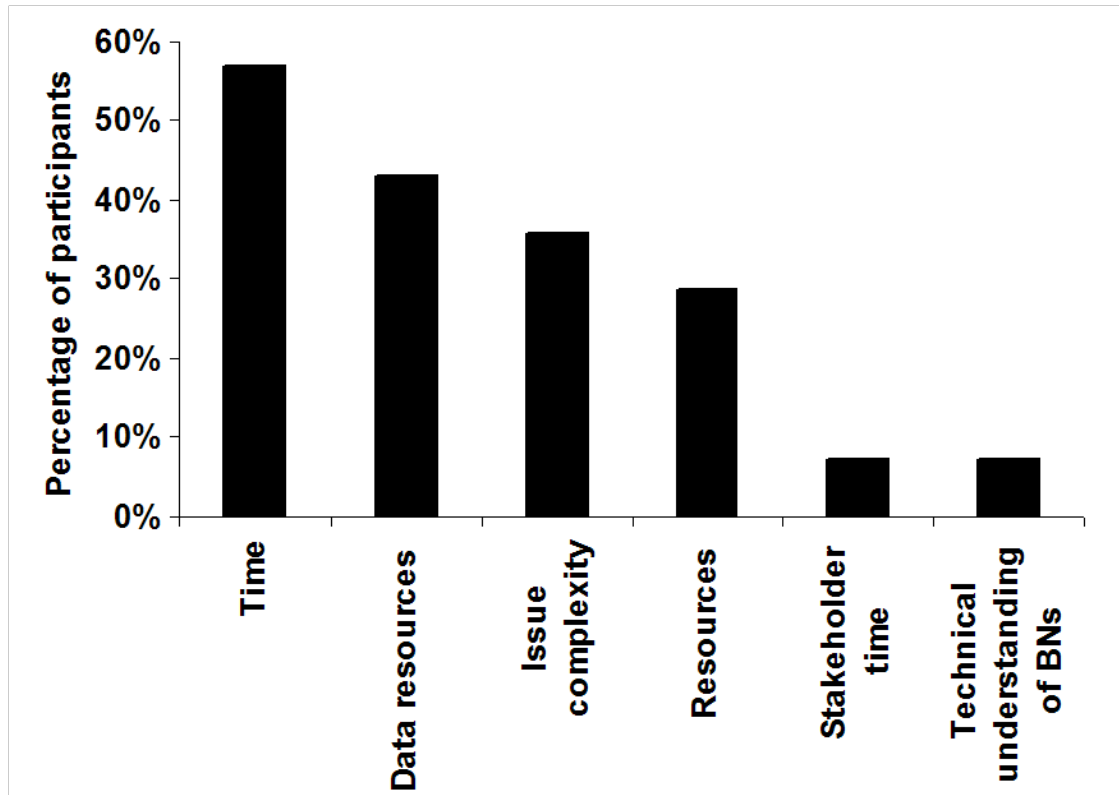


MfT: Across Programs (Soil & River health)



Burn out: CMO Limitations in Building BNs

What do you think are the limitations in using BNs for decision making particularly within your organisation?



Adoption outcomes

- **3 CMOs:** used BNs as a strategic tool
 - Project planning
 - Investment planning
- **2 CMOs:** funded projects using BNs
 - Climate change → resource condition
 - Adding to existing monitoring framework

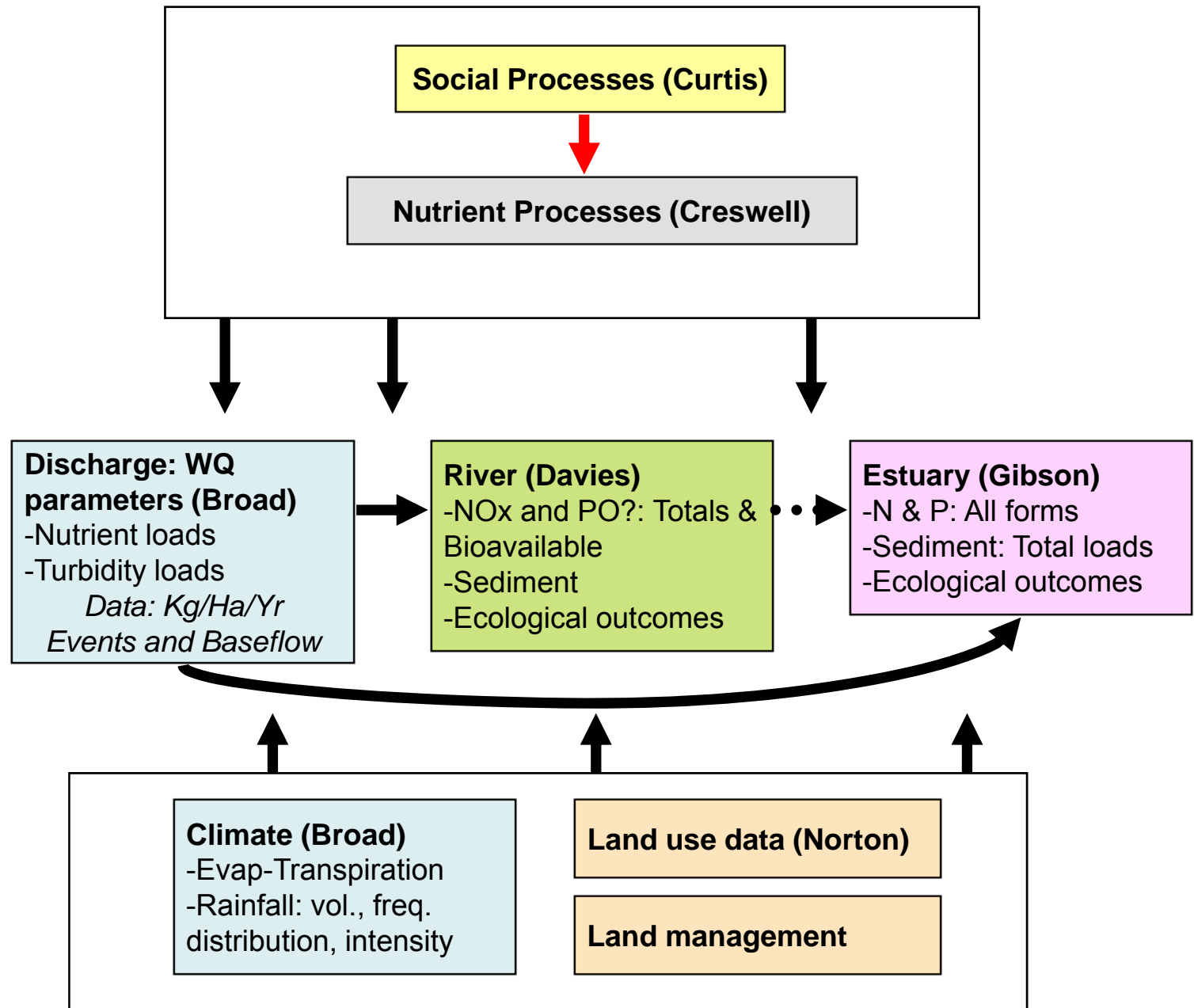
Landscape Logic:

Model Building

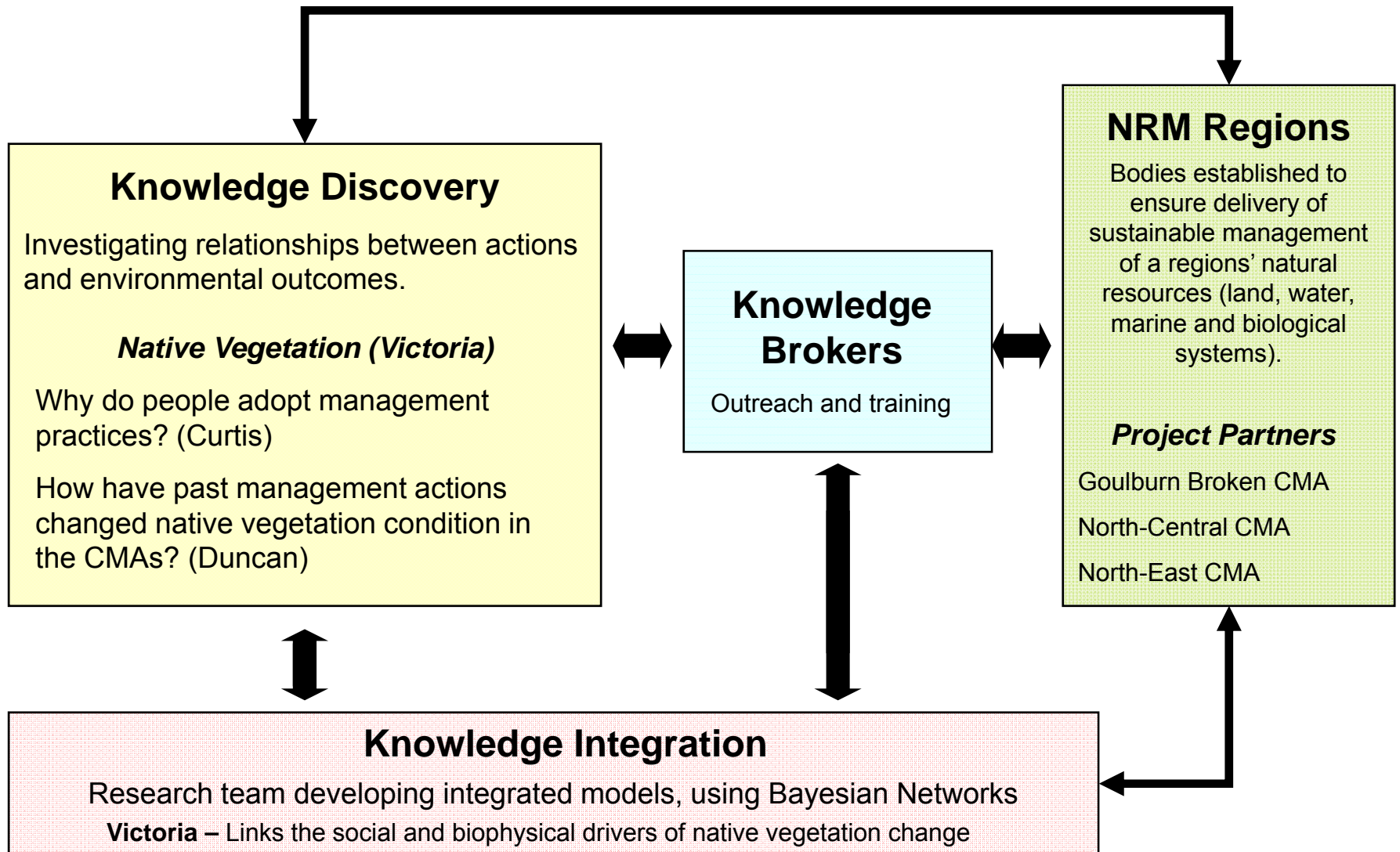
Water Quality
(Tasmania)

Vegetation condition
(Victoria)

Water Quality



Vegetation Condition



Adoption and Ongoing Use

- Development of the Landscape Logic Warehouse
 - Information, Data, Models and Decision Support Systems for integrated models



Reflections /Challenges

- NRM linkages to science and scientists (and vice versa): challenges on both sides
- Getting CMO engagement over the life of a project
- Lack of good data and knowledge
- Adoption, ongoing use and support





LANDSCAPE LOGIC



LINKING LAND AND WATER MANAGEMENT TO RESOURCE CONDITION TARGETS



Australian Government
**Department of the Environment
and Water Resources**

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