Irrigated agriculture in northern Australia, photo Michael Douglas.

Northern Australia Environmental Resources Hub

National Environmental Science Programme

Tools and models to support sustainable development decisions in northern Australia

Wrap-up factsheet

Many tools exist to support sustainable development decisions

There is a lot of interest in developing northern Australia while also caring for its unique natural landscape. However, trying to decide how to develop and protect at the same time can be a challenge. There are many tools and models available to inform these decisions, including integrated models, frameworks, and decision support tools, but there are so many different kinds that it's difficult to determine which might be best suited to inform different decisions. The aim of this project was to create a resource to help practitioners assess the availability and suitability of particular models and the feasibility of using, developing, and maintaining different types of models to support planning and development decisions across northern Australia.

The first step is deciding whether a model is indeed the best choice to help make decisions about developing northern Australia. Other methods include public meetings, internet surveys, private consultations, negotiation and consensus-seeking approaches. Once the decision is made to proceed with data modelling or use of a model, a second round of decisions about the actual model to use should be undertaken (see decision tree on next page). **The decision tree helps practitioners choose a model that will best answer the questions they are asking.**

Outcomes of this project

- overview of key characteristics of nine major categories of models, as well as information about where to go to for more detailed information about them,
- assessment of the suitability of these models for supporting different types of development decisions in northern Australia,
- case studies for each type of model, describing how they have been used in the real world, with many examples from northern Australia, and
- a decision tree to assist practitioners in choosing an appropriate model for their needs.

More information about the ease of understanding and development of each model, as well as examples of their applications in case studies (many from northern Australia), is also provided in this decision tree. Model builders were also consulted to further inform practitioners about the potential complexity and cost of developing the different kinds of models. The decision tree, along with all its supporting information, including case studies and survey results, will be available as an online tool on the Hub website.

Selecting an integrated decision support tool

Decision-making contexts

What is the primary objective you want to achieve with your decision support tool?

Protect the environment at least cost to society

What are the specific research questions that you want the decision support tool to answer?

- Identify regions to protect (or actions to undertake) to generate most environmental benefit at least economic cost
- Assess way in which external changes (climate, modifications to environment) are likely to impact species
- Assess way in which external changes (e.g. climate, water resource extraction) are likely to impact hydrology and water-dependent ecosystems and industries/economies
- Highlight market and non-market values associated with the environment and way in which external changes could impact them

Conservation planning models

- Moderately difficult to understand.
- Expensive to develop from scratch, but 'off-the-shelf' models available (still require labour to contextualise).
- Case studies from Mitchell River and pan-northern Australia show use for identifying priority sites or actions for conservation.

Species distribution models

- Relatively easy to understand.
- Expensive to develop from scratch, but 'off-the-shelf' models available (still require labour to contextualise).
- Case studies from northern Australia show use for predicting areas of conservation value and changes in bird distributions with climate change.

Hydrodynamic models

- Relatively easy to understand.
- Expensive to develop from scratch, but 'off-the-shelf' models available (still need labour to contextualise).
- Case studies from Flinders and Gilbert Rivers and pan-northern Australia show use for assessing risk from altered flows and predicting nutrient load changes from land management.

Protect society at least cost to the environment

What are the specific research questions that you want the decision support tool to answer?

- Assess way in which changes in a single industry will affect the natural environment (or changes to environment will affect an industry)
- Assess way in which external economic changes are likely to affect the local economy, equity and parts of the natural environment

Asset evaluation models

- Moderately difficult to understand.
- Benefit transfer possible (reducing costs to < $200k), but not always possible to do so. Can be expensive to assess multiple asset values particularly in complex connected ecosystems.
- Case studies from Mission Beach and Victoria show use for identifying projects with high benefit:cost, and regions with high ecological and socio-cultural values for use in a conservation planning model.

Bio-economic models

- Can be difficult to understand.
- Complex models can be expensive but simpler versions can be developed for < $500k.
- Case studies from the Kimberley and Flinders River show use for assessing water harvesting profitability under climate change and predicting impact of mimosa on cattle industry.

Regional models

- Can be difficult to understand.
- Most very expensive to develop (millions of dollars and several decades) but 'bottom-up' approaches relatively cheap.
- Case studies from Daly and Mitchell Rivers and Qld show use for predicting water demand with different development scenarios and regional economic impact of drought on agriculture.

Understand interactions between people and the environment, and the potential impacts of change on both society and the environment

What are the specific research questions that you want the decision support tool to answer?

- Learn about which parts of the system are connected to other parts and identify those parts which may be 'at risk' of different changes elsewhere
- Understand how 'behaviour' of small individual parts of the system can collectively generate outcomes; learn about impact of multiple individual behaviours
- Learn how complex interactions within and between parts of the system affect each other; explore cross-realm outcomes of changes within sub-systems

Network-based models

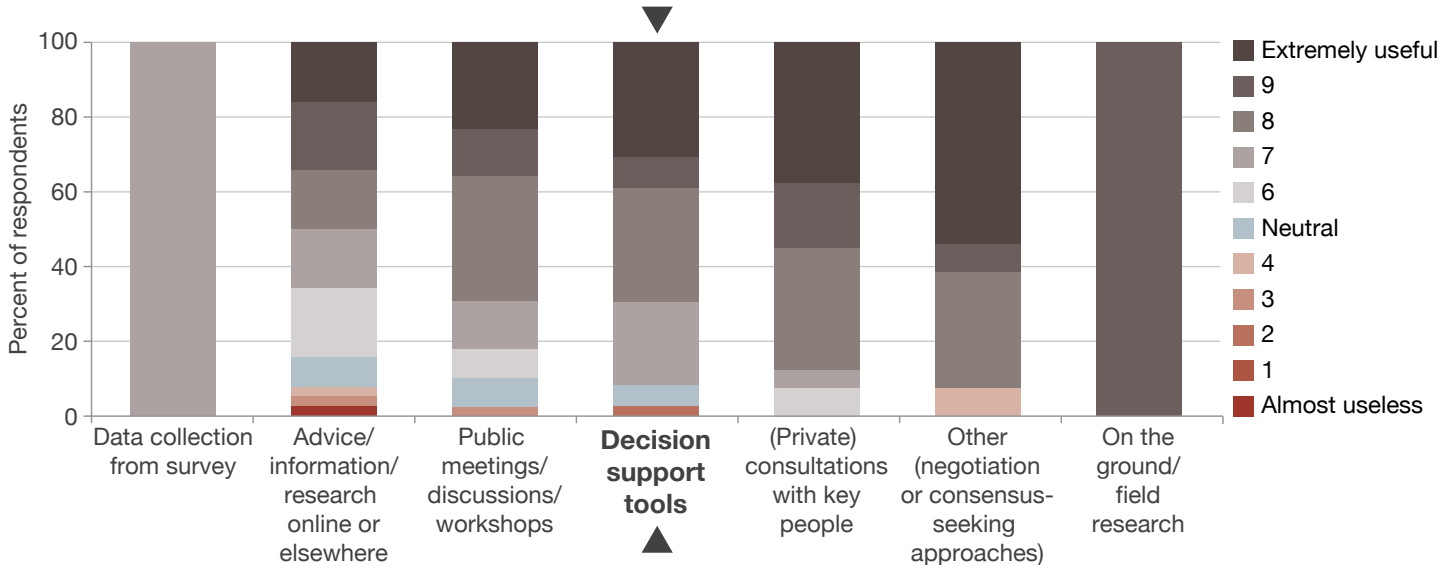
- Can be difficult to understand but visuals are powerful.
- Off-the-shelf software available; costs associated with collection of data (can likely develop reasonable model for < $200k).
- Case studies from Daly River and Tasmania show use for identifying fish and habitats at risk from water extraction, and non-market values affected by water management scenarios.

Agent-based modelling

- Can be difficult to understand but visuals are powerful.
- Off-the-shelf software available; costs associated with collection of data (can likely develop reasonable model for < $200k).
- Case studies from northern Australia and USA show use for assessing causes of and responses to reduced banana prawn catch, and predicting river and fish health under various scenarios.

Systems models

- Can be difficult to understand if no visuals.
- Simple models inexpensive to develop using off-the-shelf software. Millions of dollars and several decades for complex models.
- Case studies from Australia show use for assessing outcomes of fish management scenarios, and implications of water allocations.



Decision-makers use a variety of methods to gather information before deciding on a course of action. Decision support tools are just one of these methods. In a survey of 40 potential users, decision support tools were generally rated as more useful than methods like public meetings and internet surveys, but often less useful than private consultations, negotiation and consensus-seeking approaches. Tools that displayed outputs visually were often considered to be the most useful and the most able to influence policy.

No single tool can answer every question

The sheer number of different decision support tools available means that practitioners need a way to choose which tool will work the best for the questions they are trying to answer. In addition to generating the decision tree on the previous page, this project also identified real-world case studies for each of the nine model types, many from northern Australia, with the goal of assessing the feasibility of using, developing, and maintaining decision support tools. Each case study is organised as follows: what they set out to do, what they tried, what results they achieved, what they learnt, and what they may need to do next.

It is essential to include key stakeholders in all deliberations, including those relating to model choice. The manner in which decisions are made, including the perceived fairness of the process, is just as important to their success as the tangible outcomes of decision-making. Policies (particularly those relating to natural resource management) often fail when the knowledge and values of the local community and other stakeholders are not included. Some additional methods for gathering information to help inform decision-making are outlined in the figure above.

Decision support tools help make the decision-making process transparent, reproducible, robust, and can provide a coherent framework to explore options. But they are not, and should not, be a substitute for thinking about complex problems in other ways. They are, instead, complementary. There is evidence to suggest that better computers do not, by themselves, lead to better decisions. The same is likely also true of decision support tools.

Further information

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Visit: www.nespnorthern.edu.au

This factsheet and the full report 'Integrated models, frameworks and decision support tools to guide management and planning in Northern Australia' are available from: http://www.nespnorthern.edu.au/projects/nesp/review-of-models-frameworks-and-decision-support-tools-for-northern-australia

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