Community participation in sustainable irrigation research

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Background

Many of the research projects commissioned by the National Program for Sustainable Irrigation (NPSI) have adopted innovative approaches to achieve strong connections between the researchers and the rest of the community. Finding ways to include the practical knowledge that comes from the community into research is crucial to achieving a sustainable future.

This research bulletin outlines approaches to engaging with communities that have been successfully developed and applied by NPSI projects. The complementary nature of the processes is emphasised.

Goulburn Broken Irrigation Futures: Future Stories

The regional economy of the Goulburn Broken catchment in northern Victoria is driven by irrigation. The regional farm-gate gross value of production from irrigated agriculture in 2000 was $1.35 billion. However, irrigation is facing enormous challenges. As one of Australia's oldest gravity-fed irrigation systems, irrigation infrastructure is reaching the end of its useful life. An increasingly stringent regulatory environment, coupled with community expectations for the improvement of the natural environment add to the considerations of where, and how, irrigation is undertaken in the future.

This project has emphasized the importance of engaging not only representative organisations in discussion about future scenarios, but also the general public. The project has run a number of locality-based sessions and met with many community groups to develop a shared vision for irrigation in the catchment. Future scenarios have been developed, by considering the history of individual districts over the past 30 years. This is a reminder of how much things have changed, and how much they might possibly change over the next 30 years. Drivers for development of scenarios were recognised as: 1) Resource shifts and allocations, 2) Consumer demand, 3) Input costs of production, 4) Community values and government policy, 5) Climate, 6) Dramatic change and 7) New and emerging technology. Scenarios from 6 different public forums have been distilled to give 4 scenarios that represent a range of views of the future, from an aggressive expansion of agribusiness through to a situation where the catchment is reaching its ecological limits of production.

The four scenarios that have been described are:

- *Moving on* - Levels of corporate farming increase along with increases in export opportunities through the signing of free trade agreements and introduction of GMOs in agriculture. Water delivery systems are rationalised and subsequently privatised. Later in the scenario, the region experiences export competition from countries that had traditionally been our markets.
- *New frontiers* - Residential development increases in rural areas. Community expectations of the environment and concerns for health increase. Government progressively tightens controls on agricultural practice,

ultimately forcing a decline in agricultural production. An international conflict arises over oil, which causes a period of technological innovation. Synthetic food products become the primary source of food, leaving a small niche authentic food industry.

- *Pendulum* - Early in the scenario, a strong community concern for the environment leads to the commitment of 3500GL to the Murray over 10 years. Agricultural production slowly declines. Later in the scenario a change of government brings an about-turn in policy. Water is reallocated to agriculture and trading conditions improve. Climate change is acknowledged as a cyclical phenomenon and the enhanced greenhouse effect is managed through a global carbon budget. Major flooding for 2 years sees water tables start to rise.
- *Drying up* - During early years, a worldwide recession leads to the loss of our major export markets for a period of 1-2 years. Later on a significant drought leads to the progressive reduction of water to irrigators (down to 30% of water right) over 3 years.

These narratives have the advantage of being readily pictured by the broader community. However, they make quantification of the likelihood of particular outcomes difficult. The next phases of the project will use a combination of quantitative and qualitative modelling to explore the likely outcomes of the scenarios (Wang, 2005). In this way, this method goes backwards and forwards in an ever-increasingly informed discussion between technical experts, institutional stakeholders, researchers and the general public. The method will be reviewed so that it can be applied elsewhere in Australia for sustainable irrigation planning at a catchment scale.

Ecological Risk Assessment: Future Numbers

Ecological Risk Assessment (ERA) has been used in a number of projects (e.g. Hart et al., 2005; Feehan, 2003; Duivenvoorden, 2003; Lund, 2005).

This approach estimates the likelihood (or probability) and consequences (or magnitude) of the effects of human actions or natural events on plants, animals and ecosystems. It provides a basis for comparing and ranking risks, so that natural resource managers can focus attention on the most severe risks first.

An Ecological Risk Assessment framework for the Australian irrigation industry has been developed (Hart et al., 2005). The framework is catchment based, and focuses on the task of assessing the risks to multiple ecological assets from multiple hazards. Occasionally there is good scientific data available to help calculate the probability of a particular risk event occurring, and the magnitude of the event (for example, the risk of a fish kill in a river). Whether or not such data is available, it is crucial that local knowledge is incorporated. Local experts use their knowledge and experience to assign risk. The prime focus of the framework is on the risks to aquatic ecosystems (rivers, wetlands, estuaries) but it should also be applicable to the measurement of risks to other natural resource assets, such as the soil, vegetation and animal diversity. The core of ERA is in the assignment of the likelihood of particular risks occurring.

Semi-quantitative risk analysis uses surveys to collect information. Users are asked to assign scores on the scale of 1 to 5 for:

- the likelihood of the ecological effect occurring (ranging from highly unlikely to almost certain)

- the magnitude (severity) of its consequences (ranging from insignificant to catastrophic).

The stakeholder risk scores (likelihood X consequences) are then ranked with possible scores ranging from 1 to 25.

Quantitative risk assessment methods (see Burgman, 2005) can include the effect of a single stress upon the environment, such as a chemical spill, and the measured result in animal deaths, or larger scale predictive models that attempt to integrate a number of stresses and the likely consequences from these. Bayesian networks are becoming a common approach to dealing with multiple stress problems as they are able to incorporate information with high uncertainty, including poor or incomplete understanding of the system and they are able to combine both empirical data and expert opinion. Network diagrams are explicit about the cause and effect relationships. An illustration of a Bayesian network is shown in Figure 1.

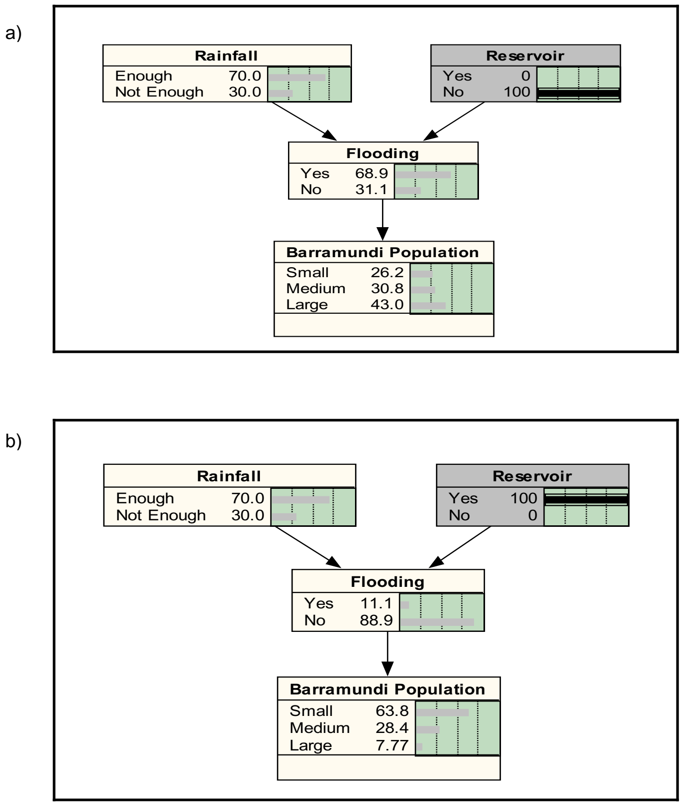

Figure 1. A Bayesian Belief Network, showing expected population size of Barramundi in a river as a result of flooding if a reservoir is a) not present and b) present (from Kellett, 2005).

Setting goalposts for the future: Ecological Indicator Frameworks

Achieving community participation in research can be difficult when the subject area is not immediately appealing, or where the language that the researchers are speaking is considered unfathomable. Recent work by Kellett, Bristow & Charlesworth (2005) provides an illustration of an alternative approach to communicating with stakeholders via the establishment of frameworks of sustainability indicators. Sustainability indicators are a series of benchmark measurements to enable measurement of sustainability in its social, cultural, economic, environmental and institutional elements. Their review of sustainability indicator frameworks recommended two approaches: AMOEBA diagrams and Bayesian networks. Both these approaches provide an avenue for discussion and input by the community.

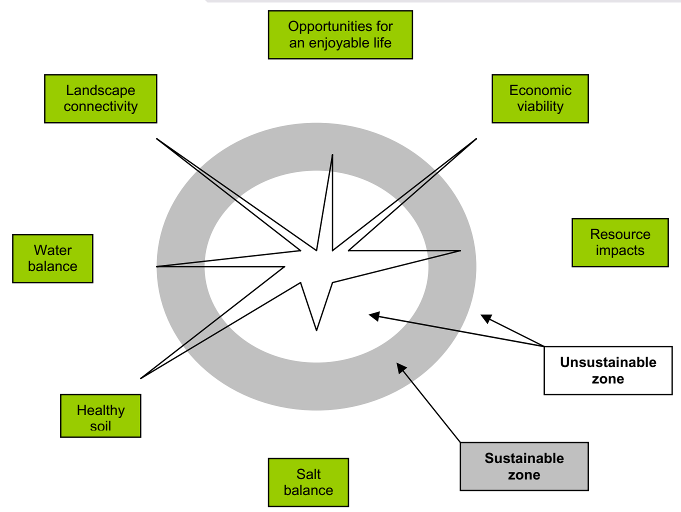

Figure 2. An AMOEBA representing the sustainability of a fictitious irrigation agroecosystem at the catchment scale (from Kellett et al., 2005).

AMOEBA (Figure 2) diagrams have the advantage of showing all the elements of the system in one diagram, and make it possible to identify those elements of the ecosystem that are not in a sustainable condition. They are not able to show the relationships between the elements, nor are they of use for testing alternative scenarios. However Kellett et al. recommend them to rapidly convey issues to the community and to assist in setting threshold sustainability levels (represented by the edges of the shaded circle).

Kellett et al. (2005) identify the strengths of Bayesian networks for the development of indicator frameworks as being – their use of hierarchies to give context to the organisation of sustainability indicators, their ability to show the balance between different states of sustainability indicators and their ability to be employed at a range of different scales. Importantly they also emphasise the role of Bayesian networks in allowing community participation in research, as the assumptions used by scientists can be readily considered by the community and adjusted in the light of new knowledge.

Conclusions

NPSI researchers have sought innovative ways of engaging with local communities to achieve the best possible combination of local knowledge and scientific knowledge. The examples given of narrative, Bayesian networks and the use of Sustainability indicators, illustrate some of the different approaches in use.

Further Reading

Visit the Knowledge Base and current research projects sections of the NPSI website for detailed information about each of the projects referred to above. www.npsi.gov.au.

Burgman, M. A. (2005). Risks and decisions for conservation and environmental management. Cambridge Univ Press, Cambridge.

Duivenvoorden, L. J., M. Price, R. M. Noble and C. Carroll (2003). Assessment of ecological risk associated with irrigation in the Fitzroy basin: Phase 2 - Analysis and characterisation of risk with emphasis on effects on macroinvertebrates. NPSI Final Report UCQ3. 8 pp. http://www.lwa.gov.au/downloads/publications_pdf/ER030962.pdf

Feehan, P., J. A. Webb, T. U. Chan, C. A. Pollino, N. A. Linacre and M. Grace (2003). Ecological Risk Associated with Irrigation in the Goulburn Broken - Stage 2.NPSI Final Report GMW11. 18 pp.

Hart, B., M. Burgman, A. Webb, G. Allison, M. Chapman, L. J. Duivenvoorden, P. Feehan, M. Grace, M. A. Lund, C. A. Pollino, J. Carey and A. McCrea (2005). Ecological Risk Management Framework for the Irrigation Industry.NPSI Final Report UMO40. 62 pp. http://www.wsc.monash.edu.au/publications/2005ERAIrrigationFramework.pdf (1.8Mb)

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Lund, M. A. and A. McCrea (2005). Ecological risk assessment associated with irrigation in the Ord - Phase 2.Ecological risk assessment associated with the impact of irrigation return on biodiversity in the Ord River.NPSI Milestone 5 Report WRC12. 66 pp.

Wang, Q. J., L. Soste and D. Robertson (2005). Irrigation Futures of the Goulburn Broken Catchment.NPSI Milestone 3 Report VPI3. 8 pp. (with 105 pages of Appendices).

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