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Transparency and trade-offs in water planning

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SUMMARY

The building of robust and transparent trade-offs needs to be supported by a sound understanding of the water planning process, baseline conditions, and the range of interests and values that might be affected. To this end, several tools were tested for identifying interests and values and assessing how they might be impacted by change. These included a social impact study in South Australia and irrigator and stakeholder surveys in the Condamine, Queensland. A participatory approach to multiple criteria analysis was also trialled to assist understanding of preferences and values in water allocation trade-off deliberations. Evaluations of the use of these tools demonstrate their functionality in eliciting stakeholder values and expectations and help in bringing transparency to the logic behind the water planning decision-making process.

1. Introduction

The main challenge in Australian water reform is reducing over-allocation or overuse of water to restore environmental flow. Adjustment to the way in which water is shared between the different uses is inevitable given long-term climate change that is predicted to result in declines in rainfall, reduction in inflows into river systems, and an increase in temperatures and evapo-transpiration (Climate Commission, 2011). Decision-making about change is highly contested, and is likely to involve a complex re-balancing of environmental, social and economic priorities.

The National Water Initiative (NWI), the pre-eminent water policy document of the Australian Government recognises there will need to be 'trade-offs between competing outcomes for water systems' (COAG, 2004, cl. 36). The NWI directs that these trade-offs will 'involve judgements informed by best available science, socio-economic analysis and community input'. Input from water users and other stakeholders will assist with achieving transparency in decision-making and ensuring that sound information is available to all sectors at key decision points (COAG, 2004, cl. 93).

These aspects of the NWI confront water planners with two clear categories of challenges – information and skills. Issues of fairness, referred to as procedural and distributional equity (Syme and Nancarrow, 2000; Syme et al., 1999) are involved. However relevant to address of social, economic, and equity issues falls outside the traditional scope of water planning which historically tend to focus on hydrological assessments, and in the past decade included ecological assessments. In addition, the skills and mechanisms to effectively engage and negotiate solutions among the broad range of interests in water are generally less well developed than other skills within the water planning community

The stakeholder and gap analyses completed in each case study area early in the Water Planning Tools (WPTs) project identified diverse groups not traditionally considered in a water planning process dominated by the contest between extractive and in-stream uses of water (Hoverman and Ayre, 2012; Mooney and Tan, 2012; Tan et al., 2012, this issue). The project gap analyses identified social and economic assessment of water management options and decision support as areas where greater capacity was needed. This confirmed an earlier review of water planning in Australia that identified social and economic assessments for water planning were: highly variable in quality (or entirely absent); assessing only a narrow range of impacts; largely associated with agency or industry groups; and made little use of primary data collection tailored to the needs of water planning (Baldwin et al., 2009). The practice has been to assume stakeholder consultation fulfils the requirement of social impact assessment but it often results in a narrow representation of impacts.

1.1. Social economic workshop

With key state government partners, we investigated a range of tools for improving the quality of socio-economic assessment. Five experts in social and economic assessment met for a 2 day workshop in 2009 with WPT project team members and representatives of Queensland and South Australian governments. The workshop addressed the two key challenges, that is, of lack of information

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and skills on the part of water planners to effectively incorporate values into decision making in a context of uncertainty and change.

In particular, the workshop explored socio-economic tools and techniques useful in water planning and identified appropriate methods for two of the WPT case study areas: the Central Condamine Alluvium (CCA) groundwater, and South Australian (SA) Regulated River Murray. These two regions were prioritized because both water plans needed to address issues of overallocation. The workshop commenced with the experts explaining their methods and sharing case studies in which they have been involved (Baldwin and Tan, 2009).

The suite of approaches and studies included:

- using travel cost, contingent valuation and contingent behaviour to estimate non-market recreation use values at Barmah and Coorong in the Murray (Brenda Dyack);
- using cost benefit analysis, choice modelling, and contingent valuation to understand resource asset values and economic impacts of changes (Jeff Bennett);
- using multiple criteria analysis to make decisions about distributing funding to manage the Great Barrier Reef (Steven Hajkowicz);
- using cost-benefit analysis, non-market analysis, choice modelling and social–economic assessment to assess impacts of mining (John Rolfe); and
- using community response theory, interviews, community profiles and analysis of influence diagrams for social impact assessment of three flow scenarios for the Murray (Helen Ross).

With government representatives, we presented information on the CCA and SA Murray case studies to clarify the need for social and economic information in water planning. Round robin discussion with the experts on how the tools could be used in each case identified a range of socio-economic tools appropriate to issues in the study areas. Selecting tools or methods of assessment is complex and time-consuming, and needed to be iterative. The tools had to be appropriate but also fit for purpose from a skill and resourcing perspective.

In both study areas, it was agreed to trial social–economic assessment methods which would provide fundamental information about values and impacts, and a decision support tool that would provide transparency of decision-making about how trade-offs are made. Tools were also developed which aimed at building up knowledge about Indigenous cultural water needs, addressed separately in this issue (Jackson et al., 2012).

The workshop identified indicators of success of social–economic assessments. These included process and stakeholder-related indicators (such as inclusion of less powerful stakeholders, transparency of decisions, less intensive disputes) and outcome and technical quality indicators (such as efficiency, community well-being, mitigation measures, defensibility and credibility of decision, and technical robustness evidenced through peer review). Robust assessments help to ensure that investments are targeted to distribute positive and negative impacts more equitably. Although these indicators were identified, we were not able to test their efficacy in our case studies because the planning processes were not completed at the time of writing. However, each tool was evaluated during and after the trials.

1.2. Socio-economic assessment

Socio-economic impact assessments document the intended and unintended social, cultural, demographic and economic consequences, both positive and negative, of interventions and possible alternatives to all major stakeholders and others that are affected or have an interest in an action (Burdge, 2004; Fenton, 2003; Vanclay et al., 2004). Ideally the impact of each option or scenario, strategy or action proposed in a plan should be assessed (Bowmer et al., 2007). The need for socio-economic assessment has been identified by the NWI which provides that planning processes should include the application of socio-economic analyses 'consistent with the level of knowledge and resource use' (COAG, 2004, Sch. 6). The importance of these assessments has been reinforced by the Commonwealth's *Water Act 2007*. Carrying out socio-economic assessments early in a process improves its potential to influence outcomes of planning by integrating the assessment into community engagement (Burdge, 2004; IAIA, 2003). Socio-economic assessments can usefully profile relevant community and industry demographic and economic characteristics, as well as attitudes, values and interests. Social science methods such as surveys, interviews and focus groups are commonly used in social impact assessment. Such information can be used to improve understanding of those that may be vulnerable to change and to identify adaptation and mitigation measures that could play a part in trade-offs.

1.3. Multiple criteria analysis

Multiple criteria analysis (MCA) refers to a number of methods of evaluating decisions where the options are measured against more than one criterion. The complexity of decision-making which involves making trade-offs about competing priorities such as between economic, environmental and social goals presents significant challenges to natural resource managers (McShane et al., 2011). MCA is a tool that provides structure and transparency around critical and complex decision-making, increasingly used with a range of stakeholders to improve legitimacy of decision-making and increasing the likelihood of problem resolution. MCA recognises that human activities are motivated by multiple, often competing criteria and constraints. As a decision-aiding process it can be an effective technique for identifying trade-offs in which there are multiple objectives; these trade-offs can be measured and evaluated. Unlike other social science techniques such as cost-benefit analysis, it does not require monetary valuation of criteria. Rather it enables qualitative aspects such as fairness and sustainability to be taken into account (Prato and Herath, 2007). MCA has been used in a number of water management contexts around the world (Hajkowicz and Collins, 2007).

The steps usually involve: identifying issues and options, identifying a set of evaluative criteria, weighting stakeholder preferences for the criteria, ranking and aggregating preferences, and evaluating options (Proctor, 2009). In its participatory form, getting stakeholders to agree on criteria and weighting is a critical component (Proctor and Drechsler, 2006). Effective processes require understanding the background and issues, and careful planning (Klauer et al., 2006).

Deliberative Multiple Criteria Evaluation (DMCE), which combines MCA with citizen jury techniques, has been used to support decision-making about natural resource management issues: for example, making decisions about options for tourism and recreation in the Goulburn Broken catchment (Proctor and Drechsler, 2006) and about different values and uses for water in Howard Springs, Northern Territory (Straton et al., 2010). Its value lies in breaking down decision problems and identifying information required to build consensus on complex problems. Where extraction needs to be reduced in a water plan, participatory MCA has potential to support difficult decision-making by clarifying to decision-makers what communities seek. Recently it has been found efficacious for structuring stakeholder participation in water governance in Canterbury, New Zealand (Lennox et al., 2011).

1.4. Participatory modelling using 'Concept'

Natural resource managers have used participatory environmental modelling to illustrate and communicate the complexity of ecosystem management (Beall and Ford, 2007). Raymond et al. (2009) have mapped community values in environmental assets and ecosystem services in South Australia using participatory geographic information system techniques. D'Aquino et al. (n.d.) describe two ways where participatory modelling is used in natural resource management decision-making. It is first used in translating and discussing technical results with non-technical stakeholders, aimed at providing information for local debates, or to seek validation of results. Second, it is used to collect participants' knowledge or points of view, chiefly to integrate local knowledge with expert knowledge or to help participants understand each other. D'Aquino et al. (n.d.) emphasise that good outcomes depend on getting the community profile of participants correct.

Concept, developed by Nick Marsh and team from eWater Cooperative Research Centre, is a form of dynamic simulation modelling that facilitates expression of and understanding about the active nature of relationships between a limited set of variables in a problem set. The objective was to trial the use of 'Concept' with a group of stakeholders to support the expression of their understanding of the natural system and the values it held. Working as a group to build a model of the components of the system and their dynamic interactions, it was hoped that discussion about values would shift away from entrenched 'positions' to a more nuanced deliberation about their breadth and depth.

2. Trialling tools for social and economic information collection

The WPT project, took place within the early stages of water planning processes in the case study catchments and tested tools intended to address information gaps around stakeholder values and interests. These inputs would contribute to higher quality trade-off decision making at later stages of the planning process. The tools trialled were a social impact study in South Australia and an irrigator and stakeholder survey in the Condamine, Queensland.

2.1. Social impact assessment – SA River Murray

South Australian water planners have a statutory duty to incorporate social and economic values into water planning and to consider these impacts. In the Murray, the concept statement for the new River Murray Prescribed Water Allocation Plan identified a number of assessments on the impact of changing water security arising from proposed more sustainable management of the resource, the drought and the potential impacts of climate change. After the workshop outlined earlier, it was determined that we trial a participatory and qualitative social impact assessment of the changes in water availability in a pilot study area below Lock 1 at Blanchetown (see map, Mooney and Tan, 2012, this issue). The South Australian Murray Darling Basin Natural Resource Management Board (the Board) required an understanding of the impact of several water scenarios: a drought scenario which was the baseline (at 20% of current allocation); a 'new normal' estimated at 80% of current allocation; and an interim scenario of 30% of current allocation.

Mooney and Tan elaborate on the context, methodology and design of this study (2012, this issue). It was aided by considerable literature on climate change adaptation and key risks facing agriculture (King et al., 2009; Beale et al., 2009).

2.1.1. Scenarios and impacts

Tracing 'influence pathways' to see how changes would track through the economy and social systems (Hassall and Associates et al., 2003) facilitated the development of an understanding of the multiple use and non-use values of water in the region and their flow-onto the broader local economy. The availability of water, in its broadest sense, in the case study area is affected by three factors, namely low flows, reduced allocations and drought. A fourth factor being the level of the water in the river, was revealed during the study.

The project was able to gather a rich picture of the Murraylands region, identifying strengths (potential to develop alternative industries, quality of life factors making it an attractive alternative residence to Adelaide, growing diversification in the economic base) and weaknesses (local economy highly dependent on water, poor condition of the riverine environment, relatively low socio-economic indicators in education and income). A large number of factors were documented that would contribute to the impacts of change, including the demise of managed investment schemes, commodity prices, water trading and Commonwealth buy-back of water, and the mining boom affecting availability of labour. The profile drew attention to the scope of activities that depend on water both in-stream (tourism) and extracted (irrigated agriculture and secondary processing). The assessment was able to give a picture of expected outcomes in the three scenarios. The approach meant potential positive impacts of change could be identified, as well as negative impacts.

2.1.2. Adaptive capacity and resilience

One of the key aspects of this qualitative approach was to identify adaptive capacity (Fleming and Vauclay, 2009) or social resilience of different sectors in response to change. Although these matters are dependent on individual behaviour or responses, it is helpful to draw some observations regarding the capacity of an region or community to manage change. The vulnerability or resilience of a community to change is influenced by the dependency on the resource and in broad terms by the store of resources that exist at the time of change. For this reason the assessment used descriptors which reveal *dependence* and incorporated *cumulative* factors likely to influence the outcomes of change. These factors impact upon the *capacity to adapt* and the *potential severity of impacts*.

A resilience approach to social assessment incorporates complexity, recognises that response to change is dynamic and provides a way of assessing the resources and adaptive capacities of a community rather than just its vulnerabilities (Maguire and Cartwright, 2008). For example, in application to the dairy industry in the pilot region, we note its dependence on irrigation, and a raft of cumulative factors as a consequence of long term structural change in response to industry deregulation and the need for improved environmental performance. Typically, the smaller operators within the industry have limited capacity to adapt as they face high farm debt and have poor debt servicing capacity. Therefore at the cessation of drought and at 60–80% of current water allocations, land in the pilot region no longer used for dairying will probably either convert to beef cattle production or be subdivided for larger rural living blocks.

The results showed the high level of water dependency within the region and its vulnerability to future changes. The regional responses to reduced water availability were identified and described in relation to the farm sector and the tourism/recreation sector. The impacts in both sectors were significant however there was considerable evidence of business adaptation to the new operating environment. In the farm sector it was reported that some growers had introduced practice change and new technology and maintained production with less water. Water trading was identified as a strategy used to both complement water allocation for productive purposes and generate income by trading out water. Some growers moved production to other areas and others ceased

active farming altogether. There were examples of adaptation to changing circumstances and clear indications of the limits of capacity to adjust. The mobility of key assets in the tourism and recreation sector provides capacity to adjust to long term impacts. There was particular concern about the diffuse impacts of the downturn of regional tourism and local recreation on small business operators along the River.

2.1.3. Implications for planning

The social impact study in the Murraylands reinforced concern about the impacts or reduced water availability on irrigated agriculture. Significantly, it also drew attention to the broader impacts on the tourism industry and the regional economy through loss of economic activity and increases in costs. The study found there are likely to be intra-regional effects associated with the level of dependence on water and the degree of diversification of a particular community. The trend towards contraction of small highly agriculture-dependent communities is likely to be intensified by changes brought about by drought, low flows and restricted water allocation. The method contributed significant information to the water planning process. The paucity of socio-economic data at sub-catchment scales is an impediment to the understanding of impacts and design of mitigation (Curtis et al., 2005). The challenges of integrating socio-economic and biophysical data to support water allocation decision making at this fine-grained scale are significant (de Lange et al., n.d.). Given appropriate support, this relatively low technology method could be utilised by water planners to develop an understanding of the broader impacts of change within a planning region.

2.1.4. Limitations of the method

A secondary aim of the study was to identify critical thresholds for different water users, communities and industries. Within the time frame and resources available, this proved too complex. While providing a rich record of range of extractive and non-extractive dependencies on water in the Murraylands, and the range of impacts of change and suite of factors that influence the outcomes of change, the method itself was time consuming.

2.2. Irrigator survey – Central Condamine

In the Condamine case study, one of the potential management alternatives to depleting groundwater resources was to cut licensed entitlement from 90 Gigalitres per annum (GLPA) to a level of sustainable use estimated at 40 GLPA, potentially a 55% cut in entitlements (Tan et al., 2012, this issue). As there was a level of uncertainty regarding the estimate of sustainable diversion limit, the project team decided that socio-economic information would inform decision-makers as to the impact on the community from any such reduction in entitlements. By 2009 the water agency had commissioned a farm-scale analysis of farm businesses, which at time of writing has still not been released. Instead of carrying out a desk-top analysis of socio-economic data, the WPT team thought it would be more valuable to collect a wider range of views beyond those with whom the Community Reference Panel (CRP) or the state agency might have regular contact. Such collection of data is well canvassed in research, but outside the scope of traditional water planning process.

As the impact of cuts would primarily impact licensed water users, their views were highly relevant. Thus instead of surveying a broad cross-section of the community, we focused on collecting information on water users' perceptions of potential risks in setting the sustainable diversion limit and challenges in meeting that limit. In doing so the questions also elicited their socio-economic values in water in a bid to identify areas for trade-offs in making decisions. Details as to the survey results are found in White et al. (2010).

Two key challenges in carrying out the survey were:

- Framing questions relating to complex water management matters while ensuring a balance between explaining the issue and canvassing information. The survey questionnaire could have been improved by carrying out a pilot survey, and adjusting the survey questions.
- A relatively low response rate to the mail questionnaire: 43 (18%) of the 235 groundwater licensees in the Condamine responded, in spite of reminder telephone calls.

The outcomes were conveyed to the CRP which makes recommendations to the Minister. Notwithstanding the challenges encountered, there were several positive outcomes for the survey. Although the respondents were concerned about the sustainable diversion limit of 40 GLPA, and questioned the science about climate change and coal seam gas effects, they more or less accepted the limit. This was probably because of the Department of Environment and Resource Management's stance that it would accept a CSIRO recommendation (CSIRO, 2008) to set 40 GLPA as the limit. Licensees placed a high value on equitable processes, and on this basis a majority (between to 60.5% to 76.7%) rejected several options that provided for differential cutbacks based on property location and unsustainable use by individuals. They overwhelmingly supported a cut of entitlements "across the board", applying to all user types including urban. Information from the survey also provided input to setting up the DMCE, described below.

3. Trialling tools to assist deliberation and decisions involving trade-offs

In addition to the activities discussed above, the WPT project trialled the use of DMCE and *Concept*, aimed at supporting effective trade-offs in decision making. In the Murray the role of social values in environmental prioritization in the context of water scarcity was addressed. A robust deliberative process helped to facilitate thoughtful consideration of the advantages and disadvantages of a range of potential options. In the Condamine, the question of concern was how proposed cut-backs should be shared between extractive water users. The question was expected to generate heated debate. In both cases the tools brought important new information to the deliberation and facilitated a more robust debate of the options and potential trade-offs.

3.1. Trial of concept and DMCE in South Australia

The Murray trial focused on exploring the suite of social values relevant to the prioritisation of environmental assets in the context of water scarcity (see Mooney and Tan, 2012, this issue). For the purposes of this trial, the broader question about environmental assets was narrowed to consideration of the provision of environmental flows to wetlands. There were two reasons for this: first, the South Australia Murray Darling Basin Natural Resource Management Board had some control over watering a number of regulated wetlands; and second, this was a more specific question than that which could reasonably addressed within the our project's time constraints. The three dimensions of the issue that were examined through the deliberative processes were: identification of the environmental assets of wetlands that the community valued (i.e. bird breeding, fish breeding, river red gums); the social use values (i.e. camping, fishing, aesthetics); and the interaction or overlap of the two sets of values.

A nested methodology was used in this investigation. It involved the use of different tools in two stages:

1. *Concept*—a conceptual modelling tool described above.
2. *Deliberative multi-criteria evaluation (DMCE)*—a decision support tool that helps identify values and their priority and then investigate the trade-offs between them.

Throughout the process the community were represented by a group of people invited to participate on the basis of their interest ('Representative Group'). As far as possible the Representative Group was intended to include people of different gender, age, occupation and interest including irrigation, environmental, local government and broader basin-scale stakeholders. The group would have been more representative if Indigenous interests and outside basin interests were better represented. There was also some concern that the forum was not entirely conducive to the participation of the 'young person' who none-the-less made some very worthwhile contributions. This Group participated in a trial of *Concept* and then followed through into the DMCE process.

Concept was used with three different groups (environmental managers, water users and 'the community'). The modelling exercise took place in a day long workshop. In the first instance participants identified the stakeholders (interests) and values they believed to be relevant to the question. They were asked to identify the condition of those values (see Fig. 1). The modellers did a 'live build' and the participants went on to describe the interactions they saw between the values, interests and quantity of water in the wetland. For the purposes of this process the parameters ranged between a full wetland and an empty wetland. When the model was completed 'gaming' could be undertaken in which the change in condition could be seen in response to a change in the amount of water available in the wetland.

The exercise had some practical outcomes. This included a stakeholder list and identification of the range of values that people believed wetlands provided. It was a fascinating process that enabled a group of people to express and then represent their world view. This process led to lively deliberation about what was important and shifted the discussion from a suite of highly contested stances to a more subtle process of exploring shared values and difference. The use of *Concept* was rated highly by the participants in the trials.

The second part of this deliberative process involved building on the information and relationships that had been developed through *Concept*. A complied list of values was taken forward into the DMCE. The Representative Group participated in two additional workshops. The first of these involved refining the values list, facilitating discussion about the values and then a voting process which led to the first prioritization. The DMCE process is designed to facilitate informed discussion and the areas in which there was most disagreement were identified and expertise provided at the second workshop to enrich the discussions. Experts in the areas of ecological health, wetland values and Indigenous values gave presentations and answered questions. Unfortunately, an area for which no expertise could be provided was 'social health'. This was of considerable interest to the Representative Group which had strong views about the importance of healthy wetlands to physical and mental health. As part of DMCE, an 'impact matrix' was developed to help participants understand the implications of their choices. In broad terms the impact matrix was able to identify the types of wetlands that would receive water as a consequence of the prioritisation the Representative Group proposed.

Participants in the trial considered ecological health to be the most important value relevant to wetlands in the context of water *scarcity*. This was followed by the contribution the wetland makes to community social well-being, its role as refugia and habitat for threatened species, and its recognition traditionally, nationally or globally as a significant site. Table 1 shows the relative importance of wetland values at the final iteration and the highest degree of consensus. Results demonstrate a high degree of convergence between environmental and social values in expressed community preference for wetland preservation. Through this approach, the degree of consensus amongst participants provided the agencies with community endorsement for the terms of assessment of wetlands and other environmental assets in the allocation of environmental water. Outcomes from this prioritisation clearly demonstrate the need for more information on the River Murray wetlands in relation to social wellbeing, cultural significance, Indigenous use and heritage values, and research and education potential. Meeting

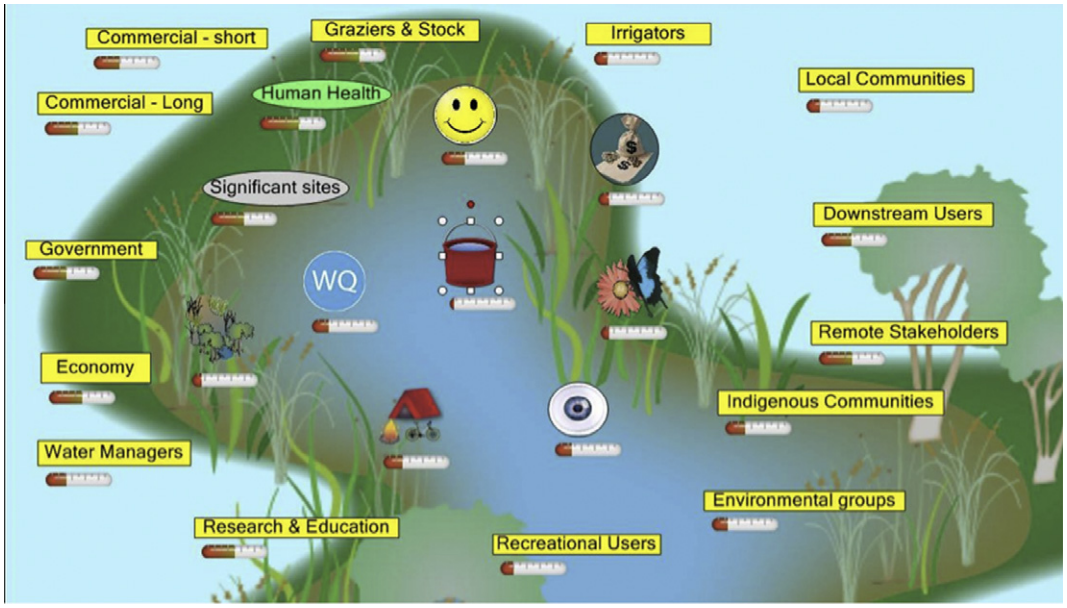

Fig. 1. Concept model including stakeholders, values and the condition of values relative to the amount of water available in the system.

Table 1
Comparison of relative importance of wetland values at final iteration and highest degree of consensus.

Criteria	Final weighting (%)	Weighting at highest consensus (%)
Ecological health	27.6	24.05
Social well-being	19.4	15.49
Threatened species and habitat	11.2	14.41
Significant sites	12.3	13.26
Indigenous values	8.7	8.58
Recreational activity	6.9	9.51
Regional economy	5.9	6.54
Research and education	8.0	8.17

these data and research needs will assist water managers to make better informed decisions about the management of key assets based on both environmental and socio-cultural values. Participants said they had a much better understanding of the suite of values situated in wetlands and the diversity of understanding about these values.

3.2. Trial of DMCE in Queensland

In the Condamine, the DMCE was designed to facilitate deliberations of a statutory CRP to assist in identifying the sustainable yield target and clarifying the alternative options for reducing the level of current entitlement to achieve that target (see Tan et al., 2012, this issue). The DMCE process was also intended to surface the range of criteria being used by each participant in determining their preferred management arrangements. The alternative management options presented by the water planners ranged from uniform reductions to a variety of methods for calculating differential reductions. In considering these options through a DMCE process, the WPT team intended to generate a transparent record of the range of views and considerations within the community for formulating advice to government on future water allocation scenarios for the resource.

The extent of the reduction in water entitlements was expected to generate significant conflict both within and across stakeholder groups over the distribution of those reductions across the community and water-use sectors. The DMCE was intended to provide a forum to help articulate the dilemmas confronting sustainable use of the aquifer and aid in resolving potential conflict over reduction pathways.

The first of two sessions proposed to assist the CRP to identify a sustainable yield volume for the system and work through the range of alternative management scenarios for meeting that sustainable yield. In an unexpected turn of events, the CRP was able to reach agreement fairly readily on a 40GLPA yield for the system as an agreed point of reference for the purposes of defining the reduction targets. Researchers continued to ask the CRP to consider whether a portion of the allocation should be reserved to take account of factors such as inexact science due to unmetered extraction and stock and domestic uses, Indigenous values and interests, and the intergenerational concept of restoring the aquifer. The findings from the survey were presented to the group to provide an additional perspective from licensees. The CRP rejected making a recommendation allowing for these three issues. However, opinion regarding whether town water supply should also be exempted was divided, and the CRP agreed to investigate options for two alternative targets, one-where town supply was subject to reductions in allocation, and the other where it was not.

The group then considered hypothetical strategies for reducing water entitlements, and was invited to eliminate, combine, refine or propose additional management arrangements. Two alternative reduction strategies were proposed: uniform, proportional reductions (or 'cuts across the board') or variable reductions based on the aquifer performance in different management areas. Alternative reduction strategies were considered but rejected, such as differential reductions based on access to alternative supply options, adoption of water use efficiencies, history of use and sector-specific requirements.

Over the course of the previous deliberation, participants revealed a distinct preference for uniform reductions based on the perceived equity of this approach for all stakeholders involved. Through the discussions engendered, participants likewise demonstrated a preference for the flexibility provided by trading and carefully designed distribution rules, whilst ensuring as far as practicable that the approach adopted did not favour any specific user or class of water user. In effect, the view reached by the CRP was almost identical to the majority view from the groundwater licensee surveys, information of which was provided to the CRP. The anticipated deliberation did not proceed and the DMCE as designed was abandoned for reasons described below.

4. Discussion and evaluation

In the SA River Murray, the trial of the nested methodology for exploring social values in prioritising environmental options in the context of water scarcity has been promising. The tools were successful at facilitating deliberation about a complex problem in a way that helped to shift participants from entrenched positions to a more expansive examination of values. The information on values identified in the *Concept* workshops fed directly into the DMCE process and contributed to both the quality of deliberations and the efficiency of the process.

The nested methodology which combined the use of a participatory modelling tool 'Concept' with DMCE proved to be a valuable tool for surfacing new information about values and facilitating dialogue about their relative priority. The quality of dialogue and deliberation facilitated by the tools was high. In both case study areas, processes were used to engage stakeholders who otherwise would not have been heard such as Aboriginal people and youth (Tan et al., 2012, this issue). The processes enabled not just new voices but new values to be inserted into the deliberations about the sharing of water. The outcomes of these discussions provide some of the input into constructing the DMCE in both cases.

While the use of DMCE in the Condamine ultimately provided transparency and articulation of the logic behind the CRP decision, it may have been more effective if it had been used with the CRP from the beginning of the planning process. This would have enabled greater deliberation about some of the other factors such as intergenerational or cultural equity that need not have reduced the allocation further but might have stimulated an innovative approach by highly engaged participants.

The abandonment of the DMCE process by participants provides some lessons in relation to transparency in trade-off decisions. DMCE and similar tools for revealing preferences in trade-off decisions can help resolve conflicts occurring in different domains for different users, where the underlying basis of that conflict is not explicit. In other words, they are useful when there is no consensus to a choice and the basis on which individuals are arriving at that choice are different, incompatible or are not explicit. In the Condamine, the deliberation of participants had largely resolved the issues intended for the DMCE. Following discussion on reduction strategies, the stakeholder reference group had agreed that a 'cut across the board' with 'everyone in' was the most defensible and fair strategy for reductions. It became apparent that the DMCE, which was initially intended as a deliberative process, was rendered unnecessary by agreements the group had already reached.

The DMCE, as a tool for clarifying discord or for revealing differences in values, was out of place. As such, whilst DMCE can serve to provide greater transparency and articulate the structural logic behind a trade-off decision, pre-existing agreement is likely to reduce the value and buy-in of the group to the process itself.

Our research identified indicators that could identify if such techniques were successful. In terms of process and stakeholder-related indicators, our processes included less powerful stakeholders and greater transparency about input to decisions. It is less clear, partly due to the unfinished state of water planning in each case, whether they have reduced disputes. In relation to the outcome and technical quality indicators, again it is premature to determine if there has been any effect on water efficiency or community well-being. However we argue that our studies contributed to discussion of mitigation measures and provided greater and more robust rationale in deliberations.

5. Conclusion

The importance of improved socio-economic assessment in water planning has been established especially in cases where there is a need for redistribution of resources to better provide for the needs of the environment and other non-consumptive uses. This presents two types of challenges to water planners. The challenges that were identified in the SA River Murray and the Condamine related to information about impacts and appropriate skills to facilitate deliberation about trade-offs between different values sets. The WPT project tested several tools for the relevance and value to issues in water planning.

The socio-economic workshop held with experts and partner agencies improved participants' understanding about methods that could be used in the current case studies (such as social impact assessment and MCA), or may be more appropriate for other water planning processes, such as cost-benefit analysis and choice modelling. It also demonstrated water planners' interest and commitment to make better use of such tools in water planning.

A better understanding of the socio-economic impacts of change should improve the quality of decision-making. The risk is that concern about the social and economic impacts of change, especially if unaccompanied by evidence and mitigation mechanisms, will be a factor in delaying action to improve provision for the environment. There is potential for more strategic responses to change, such as geographically targeted water buyback in areas of lower agricultural suitability and high social disadvantage. Measures such as this could result in better triple-bottom-line outcomes particularly in situations where environmental values can also be restored.

A water allocation plan is constrained by legislation and can only make rules about water sharing, access use and trade. The narrow mandate of water planning agencies and the absence of integrated water management means the capacity to mitigate the impacts of change is limited. To be an effective agent of change, such plans need to be integrated with broader strategies for integrated catchment management or regional economic development. Unfortunately the narrow context of the trade-off discussion is usually restricted to how much water should stay in the system and how much should be extracted, security of entitlement, and the timing of change.

A major learning for future water planning processes from the Condamine was that in both tools trialled, the irrigators' survey and the DMCE, values of procedural and distributional equity among traditional extractive users were foremost. Little value however was accorded to intergenerational or cultural equity by members of these groups of predominantly extractive users in the context of an overallocated resource. It should be noted that intergenerational values were a proxy for environmental values and a precautionary approach.

In a similarly resource constrained context where groups were more broadly constituted we found acceptance of a wider range of values. Use of *Concept* and DMCE in the SA Murray illustrated values around wetlands, particularly the interrelationship between social and environmental in-stream values.

In conclusion, the use of these tools has improved transparency about stakeholder values that provide input to decisions. A key aspect relates to how community input is gathered, and how these views may be different from main extractive stakeholders.

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