Completed Projects
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Sustainable Water Allocation

Project 3.1: Integration of Water Balance, Climate and Economic Models

Project Leader: Associate Professor Gary Codner (Monash University)

Introduction

Water resources management in Australia faces the challenge of efficient and equitable allocation of a limited resource among competing urban and rural water users and the aquatic environment. This challenge is exacerbated by the high degree of variability of the Australian climate which can produce droughts that extend over many years and over extensive regions.

The analysis of alternative water allocation policy options and water management scenarios to deal with this challenge relies heavily on models that allow the simulation of the complex physical, operational and water allocation characteristics of extensive rural water supply systems. Over the years, sophisticated modelling systems have evolved which successfully simulate the characteristics of different water supply systems under current conditions. However, their ability to model the effects of changing climate and land-use conditions, and to reflect the emerging trends and reforms in water resources management, is more limited. Furthermore, they lack the ability to translate water supply system performance measures into indicators of economic performance and regional economic impacts.

In this context, the first aim of this project was to define a set of desirable features and capabilities of an integrated modelling framework that would combine the capabilities of existing modelling systems, and allow them to be suitably enhanced to fill identified gaps in current modelling capabilities. This framework would also facilitate the application of research products from other CRC projects. A further aim was to assess the performance of existing water allocation models by analysing the sensitivity of their outputs to specific model inputs and parameters. Finally, the project was to initiate the development of new modules for identified high priority modelling capabilities.

Key learnings from the project

The analysis in the initial project phase of water allocation modelling needs and capabilities in Australia concluded that, while a common model was desirable in principle, there were overwhelming reasons for the continued use and further development of the currently used models, IQQM (used predominately in NSW and Qld) and REALM (used in Victoria, SA and WA). The different modelling approaches adopted for the southern and northern water supply systems have their justification in significant differences in the physical system characteristics and water management priorities.

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The identification of gaps in current modelling capabilities benefited greatly from the inputs of water industry representatives on the project team who had detailed knowledge of water allocation modelling requirements and the capabilities of the IQQM and REALM modelling systems. For some of the areas of perceived gaps, scoping studies provided a clearer definition of the shortcomings of current modelling approaches and the basis for the development of model enhancements. The scoping studies covered the following topics:

1. Modelling the effects of climate and socio-economic factors on crop planting and watering behaviour – while scope for improvements was identified, development of improved modules was considered to be outside the project scope.
2. Modelling the effects of climate and socio-economic factors on water trading behaviour – knowledge gained from this scoping study and from an Associated Project (see below) informed the development of the conceptual basis to model temporary water trading in Project 3A (CRC Project 2003-2006).
3. Potential for development of a module to calculate economic indicators from water allocation model outputs – this scoping study examined issues and potential modelling approaches, thus establishing the context of the economic modelling approaches adopted in Project 3A (CRC Project 2003-2006).

Following the scoping studies, the project research concentrated on selected key research areas with the following outcomes:

1. The examination of overall modelling requirements and available/emerging modelling systems produced a vision for an integrated modelling system for sustainable water allocation planning, as outlined in Schreider et al. (2001). Key elements of this vision are now being implemented in Project 3A (CRC Project 2003-2006).
2. Research on potential third party impacts of water trading led to the development and testing of a system of exchange rates for water trading between different regions. Details of this methodology are described in Etchells et al. (2002, 2003a and 2003b).
3. Analysis of the sensitivity of the Murrumbidgee IQQM and Goulburn-Broken REALM models allowed the identification of the most influential model inputs and parameters for practical model applications. These findings are summarised in Schreider et al. (2003a and 2003b) and Braddock and Schreider (2003).
4. An IQQM modelling study on the impacts of farm dams in the Gwydir system provided an assessment of the potential benefits and impacts of on-farm storages and highlighted the importance of physical storage characteristics (Ramchurn et al., 2003).
5. A CRC Associate Project undertaken at The University of Melbourne examined the factors governing water trading in the Goulburn-Murray Irrigation System, and implemented a modelling approach for temporary water trading to analyse the impacts on environmental flows (Alankarage et al., 2002).

Application

The examination of modelling capabilities and gaps concentrated initially on the application of the IQQM modelling system in the Murrumbidgee and Gwydir catchments in New South Wales, and the REALM modelling system in the Goulburn-Broken component of the Goulburn-Murray system. The results of sensitivity analyses have generally confirmed the robustness of the models of these systems and identified critical inputs and parameters for the model calibration process. Some of these findings also have relevance to IQQM or REALM models of other systems.

The major project outcome is that it has provided a firm basis for the future development of integrated hydrological and economic models of rural water supply systems.

Further information

Many of the intermediate project outcomes are available only in unpublished working documents but key results are summarised in the documents listed under 'references'

The research commenced in this project on the key areas of how to model temporary water trading and how to assess the economic impacts of different water allocation scenarios is being continued in the current CRC Project 3A 'Hydrologic and economic modelling for water allocation'. Work is also continuing on two PhD projects commenced on Project 3.1:

- Irrigated Agriculture under Uncertainty (Marnie Griffith, Monash University)
- Environmental Consequence of Water Allocation Proposals (Margot Biggin, Monash University)

The Project Team for Project 3.1 was made up as follows:

Project Leader:

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Researchers:

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Inputs from researchers and industry representatives from the following organisations are also acknowledged:

Dr Rebecca Letcher (ICAM, ANU)

Mr Ilan Salbe and Mr Steven Roberts (Department of Land and Water Conservation, NSW)

Assoc. Prof. Ian Wills (Monash University)

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