

## Sustainability Framework for Water Management in New Zealand's Canterbury Region

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**Abstract :** Introduction: The expansion of irrigation in the Canterbury region has led to the sustainability limits being reached for water availability and the cumulative effects of land use intensification. The institutional framework under New Zealand's Resource Management Act was found to be an inadequate basis for managing water at sustainability limits. An alternative paradigm for water management was developed based on collaborative governance and nested adaptive systems. This led to the formulation and implementation of the Canterbury Water Management Strategy. Methods: The nested adaptive system approach was adopted. Sustainability issues were identified at multiple spatial and time scales and defined potential failure pathways for the water resource system. These included biophysical and socio-economic issues such as water availability, cumulative effects on water quality due to land use intensification, projected changes in climate, public health, institutional arrangements, economic outcomes and externalities, and, social effects of changing technology. This led to the derivation of sustainability strategies to address these failure pathways. The collaborative governance approach involved stakeholder participation and community engagement to decide on a regional strategy; regional and zone committees of community and rūnanga (Māori groups) members to develop implementation programmes for the strategy; and, farmer collectives for operational management. Findings: The strategy identified improvements in the efficiency of use of water already allocated was more effective in improving water availability than a reliance on increased storage alone. New forms of storage with less adverse impacts were introduced, such as managed aquifer recharge and off-river storage. Reductions of nutrients from land use intensification by improving management practices has been a priority. Solutions packages for addressing the degradation of vulnerable lakes and rivers have been prepared. Biodiversity enhancement projects have been initiated. Greater involvement of Māori has led to the incorporation of kaitiakitanga (resource stewardship) into implementation programmes. Emerging issues are the need for improved integration of surface water and groundwater interactions, increased use of modelling of water and financial outcomes to guide decision making, and, equity in allocation among existing users as well as between existing and future users. Conclusions: However, sustainability analysis indicates that the proposed levels of management interventions are not sufficient to achieve community targets for water management. There is a need for more proactive recovery and rehabilitation measures. Managing to environmental limits is not sufficient, rather managing adaptive cycles is needed. Better measurement and management of water use efficiency is required. Proposed implementation packages are not sufficient to deliver desired water quality outcomes. Greater attention to targets important to environmental and recreational interests is needed to maintain trust in the collaborative process. Implementation programmes don't adequately address climate change adaptations and greenhouse gas mitigation. Affordability is a constraint on adaptive capacity of farmers and communities. More funding mechanisms are required to implement proactive measures. The legislative and institutional framework needs to be changed to incorporate water framework legislation, regional sustainability strategies and water infrastructure coordination.

**Keywords :** collaborative governance, irrigation management, nested adaptive systems, sustainable water management

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