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Knowledge Investments Underpinning National Water Reform

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Introduction

Water reform has never been higher on the Australian consciousness. We have been on this water reform journey since 1994, but unfortunately while we can agree as to what we should do, we do not seem to be able to actually do the things that we know must be done.

The degradation of many of our rivers has been obvious since last century and in all the water reform agreements since CoAG in 1994 there have been repeated commitments to correcting over allocated systems. However while water plans have secured water entitlements for irrigators, in reality little real progress has been made in restoring over allocated systems. Even the well-funded Living Murray program has only been able to achieve about half its target.

The National Water Initiative

The National Water Initiative in 2004 changed the situation, by stating that water plans had to clarify the sustainable levels of extraction, and this is what defines the consumptive pool, able to be traded between competing users. This reform put the environmental needs of the river first, rather than as last as it had been throughout the 20th century.

Section 25. v) of the NWI requires signatories to implement firm pathways and open processes for returning previously over-allocated and/or overdrawn surface and groundwater systems to *environmentally-sustainable levels of extraction*. The problem now for science and for water managers is to define just what this means.

The Challenge of Defining Over Allocation

The 2001 National Land and Water Resources Audit included maps identifying river systems thought to be over allocated, but these were engineering estimates produced with little consideration of the river health issues. There were also marked differences in the methods used by various States to make these assessments. This unsatisfactory situation has continued with States changing their definitions and approaches to this issue. Some are in denial that rivers are over allocated despite the obvious degradation. Some even argue that it is not possible to over allocate since one can only extract what water is in the river. Others who deny that their rivers are over allocated are actively seeking to recover water for these rivers that they regard as “flow stressed”.

Many states assume that sustainable yield is simply the sum of legal entitlements/ allocations. This ignores the needs of ecological assets that must be maintained and ignores the timing issue by taking a simplistic annual total.

Ongoing Measurement of River Health

Victoria and Tasmania are the only two States that have ongoing systematic efforts to measure river health. The MDBC is rolling out the Sustainable Rivers Audit at a slow pace, and there have been some efforts to measure the health of identified ecological assets such as those on the Living Murray and terminal wetlands like Narran lakes and Macquarie Marshes.

The National Water Commission has worked with the States and developed an agreed Framework for Assessing River and Wetland Health, and it is important that we start collecting data in all jurisdictions to make these judgments. The Minister has announced \$1.35 million to further trial the agreed framework in various biomes in Queensland, and it is expected that further investments will lead to it being used in other jurisdictions.

Where river health is impaired, judgments have to be made as to whether changed flow patterns are the cause of the degradation or whether other factors is relevant (eg pollution, pest invasions, riparian damage) before remediation can be attempted.

The Determination of Environmental Flows

Australia has been a leader in the determination of environmental flow rules, and in various ways these are reflected, if only partially, in many of the existing water plans.

We have gone through four stages in the development of our thinking about river flow and river health.

- Firstly, we decided that each managed river should have at least some minimum flow all the time to maintain its ecology. Some dams had minimum release rules for most of the 20th century..
- Secondly, we moved to trying to mimic natural flow patterns by releasing a certain proportion of the inflow water to a dam. This led to a “hard wiring” approach that required releases that may have been insufficient to achieve required outcomes.
- Thirdly we developed an understanding of the various ecological processes driven by different parts of the hydrograph, and we tried to build on natural flow events to ensure these processes were enabled.
- The final approach is based on identifying the important ecological assets that must be maintained, and then deciding what are the appropriate flow regimes needed to protect them. In some ways this is a form of prioritizing, in other ways a simplification of a complex decision process. It has probably led to a wider understanding, but also a view amongst some that environmental assets are little more than an irrigation field that must be watered efficiently.

The Collapse of Aquatic Ecosystems

The collapse of an aquatic ecosystem does not happen under average conditions, but under extreme conditions that stress the system beyond which it can recover.

We have observed a number of examples over the last 20 years. When we add excess nutrients to a system, it copes for a while, but then switches from a system that may have been dominated by macrophytes to one dominated by algae. An algal system can be quite stable, and may be difficult to reverse; but an algal system is generally regarded as less desirable than a macrophyte dominated system. The loss of river redgums in the Lower Murray, and the loss of parts of the Coorong in the present drought are further examples of switches that may be irreversible.

These switches when an aquatic ecosystem changes from one form to another come about when we cross some threshold – perhaps in nutrient concentration, and also in flow regimes. Commonly we have been unaware that we were stressing the river so that a threshold was approaching, and some of these thresholds, such as the loss of river redgums, are probably irreversible.

Australian aquatic ecosystems have evolved under a variable climate and are well used to droughts and floods. They have a natural capacity to recover from the stress of these natural events; this capacity we refer to as the resilience of the system.

It is important that we develop our understanding of this resilience so that we do not inadvertently reduce the resilience. For instance one clear mechanism for aquatic organisms to hang on during no flow periods is in the deeper water holes that persist when a river ceases to flow. Fish and other organisms hang on in these refuges, and can colonize the river again when flow resumes.

We have often destroyed these refuges and reduced the capacity of the system to recover from stress. We have allowed mismanagement of land leading to erosion that fills holes with sand or other materials. We may allow these remaining water holes to be pumped out to provide water during a drought. We may cause them to dry out when we extract excessive amounts of groundwater nearby.

Managing Aquatic Ecosystems in the 21st Century

We are now facing a shift in climate that is likely to lead to a drying of our landscape and perhaps increased variability in our drought-flood patterns. These changes in our climate will make changes to our aquatic ecosystem and we can expect the distribution of plants and animals to change. Our system must also cope with occasional invasions of exotic plants and animals, and of course with the pressures our society imposes through extraction of water, changing of flow regimes and the addition of pollutants.

The aim of river management in the 21st century is to retain, or where necessary, restore the resilience of the river system to cope with changes. Maintaining the various processes that

drive the aquatic system is probably more important than trying to maintain some particular favored species or community.

In our settled landscapes we have no chance of restoring rivers to any pristine condition. This is just not a possibility when we have changed the catchment vegetation and hence flow patterns. We can however seek to have a healthy river where the key ecological processes are maintained and particular high value ecological assets are protected.

Understanding the Resilience of Aquatic Ecosystems

The idea of resilience provides an appropriate framework to address the question of sustainable levels of extraction.

- Review the concept of resilience and thresholds as they apply to Australian river systems. While some Australian terrestrial work has used this framework its applicability to river systems needs to be further developed. It has been used overseas to understand switching in lake systems.
- The relationship between threatening processes and threshold responses of various aquatic organisms (fish, water birds, floodplain vegetation and invertebrates) needs to be understood.
- A collation of any existing data sets relating aquatic organisms to flow regimes and an analysis of these data sets to identify general principles.
- An update of previously published review of the water requirements of wetland and floodplain plants and plant communities identifying critical ecological processes covering maintenance dispersal and recruitment.
- Review of the various types of refugia by which aquatic organisms cope with extreme conditions. Given the importance of refugia in the resilience of aquatic systems it is important we identify the full range of important refugia beyond deep and persistent pools.
- A national synthesis of the outcomes from the various river restoration projects undertaken under the NHT program might provide further insights into best practice restoration activities.
- Review on the role of floods and multiple floods on floodplain health and resilience. Identification of the ecosystems services provided by floodplains. Develop guidelines for floodplain harvesting. Knowledge on the persistence of various ecological components of floodplains that have been alienated for various periods of time could be important if such floodplains are to be restored.
- Review as to what is known about sub surface groundwater dependent ecosystems types, ecological processes and ecosystem services

The Raising National Water Standards Program

The National Water Commission advises the Australian Government on expenditure from the \$200 million Raising National Water Standards Program. The program seeks to invest in knowledge and has nine investment areas.

- water accounting
- emerging markets
- water planning and management
- irrigation water
- water-dependent ecosystems
- urban water management
- groundwater
- northern Rivers
- national assessment of water resources

The National Water Commission has established an expert advisory group to advise the Commission on investments in this area. It is chaired by Commissioner Professor Peter Cullen and includes Prof Angela Arthington, Dr Bruce Chessman, Mr Peter Cottingham, Dr Peter Davies, Dr Jane Doolan, Prof Peter Fairweather, Dr Ray Froend, Dr Graham Harris and Prof Sam Lake

The main focus of the investments in water dependent ecosystems is:

- River and wetland health assessment.
- Identification of environmental outcomes
- Determination of sustainable levels of extraction of water.
- Identification and provision for high conservation value systems.
- Managing environmental water.

The Commission made a public call for proposals to invest in this area and received a number of proposals. Three of these were accepted for funding and have been announced by the Minister, and other areas are being further developed and will be commissioned.

- NSW Murray Wetlands Working Group – *Minimising environmental damage from wetland recovery from inland wetlands: Determining water regimes to minimise the impact of sulfidic sediments.* (\$17,520);
- University of New South Wales – *National water resource assessment using waterbirds: Ecosystem health and conservation importance of water dependent ecosystems and rivers;* (\$951,578) and
- Murray Darling Freshwater Research Centre – *Optimising environmental watering protocols to maximise benefits to native fish populations.* (\$1.85 million)

Investing in the Management of Environmental Water

It has been challenging for Governments and communities to see water being reallocated to the environment. While there is widespread agreement that we need to ensure the health of our rivers, there is also legitimate pressure that we manage the environmental water as efficiently as possible and demonstrate the benefits to the community. Some obvious areas for activity include:

- Review of environmental outcomes of flushing flows. Flushing flows are often abrupt in both the rising and falling limbs of their hydrographs. The ecological value of flushing flows remains poorly known and they may be harmful. Initially a review of what is known then possibly experimental studies
- Explore the scope, benefits and constraints of mechanisms such as environmental water trusts for provision and management of environmental water
- Facilitate a community of practice between environmental water managers across Australia will build capacity and assist with cross border issues

Conclusions

The current drought has shown us how fragile are both our aquatic ecosystems and the rural communities that depend on water from our rivers. Our mismanagement of our river systems has reduced their resilience to cope with natural events, like the current drought, and we have lost thousands of redgums that have survived many droughts in the past, and we are fast losing much of the iconic Coorong as it becomes hypersaline.

We have been on a path of water reform over the last decade, with the 1994 CoAG reforms, the 2004 National Water Initiative and the 2007 Prime Ministers Plan for Water Security. Underpinning each of these efforts has been the commitment to restore surface and groundwater systems to sustainable levels of extraction.

The challenge for aquatic scientists and river managers is to determine these sustainable levels of extraction: the challenge for our politicians is to see if they can resist the pressures of interest groups and ensure we operate within the sustainable levels.

The Australian Government is investing to build our knowledge base through the Raising National Water Standards Program. Some projects have already been announced and more are under active development. These investments give us an exciting opportunity to move forward and provide the knowledge base to allow managers to provide the healthy river systems our communities seek.