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Risk and water management in the Murray-Darling Basin

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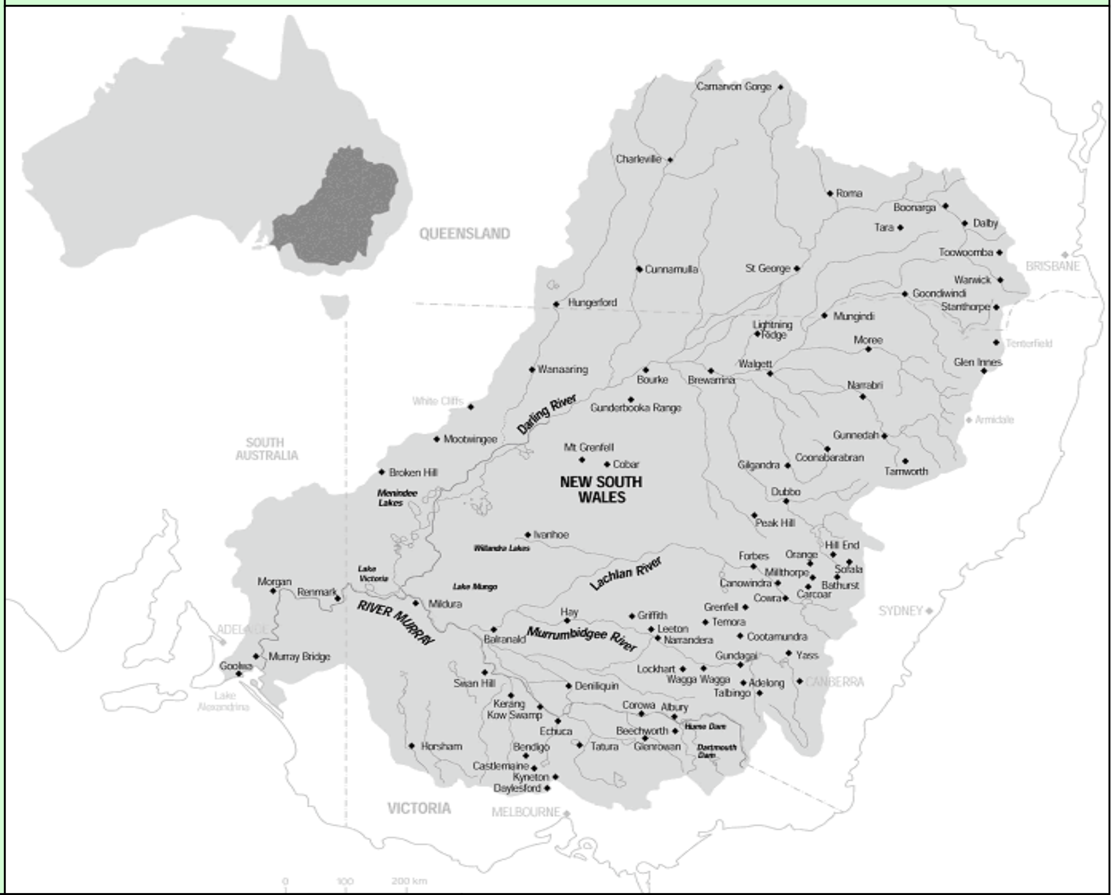

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Abstract

Most settled parts of Australia experience low and highly variable rainfall levels. Both medium-term cycles such as the Southern Oscillation and longer term climate change contribute uncertainty in additional to that arising from seasonal fluctuations. It follows that uncertainty is an inherent feature of water management in Australia. In addition, the policy process itself generates uncertainty. As new knowledge about water systems emerges and new demands, such as increased concerns about environmental flows, arise, policies must adjust. The adjustment process inevitably creates uncertainty for both new and existing water users. It follows that the allocation of risk and uncertainty is a crucial problem in the design of institutions for water management in Australia.

Water management in Australia: dealing with uncertainty

The weather is inherently uncertain, and few aspects of weather are more uncertain than rainfall in Australia. Of the world's major river systems, the Murray-Darling has not only the lowest, but by far the most variable rainfall in its catchment.

It is natural, then, to expect that the management of uncertainty should be a central issue in Australian water management, and, in important respects, this is the case.

However, paradoxical outcomes are never far away in relation to water. The oft-repeated fact that Australia is the driest continent in the world has naturally led governments to take responsibility for water supply, which has then encouraged the view that, as a necessity, water should be supplied free of charge, even for non-essential or frivolous purposes: exactly the opposite of the reasoning that might be expected in a country where water is particularly scarce.

Similarly, the very prevalence of uncertainty has, in some cases, led to demands for perfect security, either through technological approaches to 'droughtproofing', through regulatory policies designed to protect water-users from risk and uncertainty and through market-based policies based on the assumption that clearly-defined property rights can reduce uncertainty to bundles of state-contingent claim. The quest to eliminate uncertainty is futile. Uncertainty can be managed, allocated and sometimes mitigated; it can never be eliminated.

In recent years, the central role of risk and uncertainty in water management has been recognised more and more explicitly. Principles of risk allocation and mitigation have played a central role in the formulation of the National Water Initiative (COAG 2004).

The chapter is organised as follows.

The main focus of attention will be on the Murray-Darling Basin. The Basin accounts for … per cent of Australian agricultural production. Moreover, the problems of the Basin have been a major concern for Australian governments and have shaped responses to broader policy issues relating to water management.

Sources of uncertainty

Both medium-term cycles such as the Southern Oscillation and longer term climate change contribute uncertainty in additional to that arising from seasonal fluctuations. It follows that uncertainty is an inherent feature of water management in Australia. Agricultural producerrs are also subject to considerable demand uncertainty. In addition, the policy process itself generates uncertainty.

Annual and seasonal variation in rainfall

The Murray-Darling system has not only the lowest but the most variable and unpredictable rainfall of any of the worlds major river systems. Rainfall is variable and unpredictable on a range of time scales, from the very short term through annual variations to multi-year cycles such as those arising from the El Nino/Southern Oscillation phenomenon.

The distribution of natural flows in the system is characterised by high variance and high skewness. The mean annual outflow under natural conditions is about 12 300GL and the median

From a Basin-wide perspective, there has been a shift from a steady variation in mid-range flows under natural conditions to a dominance of very low flows and occasional high flow events (Thomson 1994, 10).

In its natural state, the Murray-Darling system typically displayed marked seasonal variability in flows, with high flows in Spring, following the melting of snow in the Australian Alps and low flows in late Summer and Autumn. However, this pattern was commonly disturbed by droughts and floods, which were, and remain, unpredictable. Not only has irrigation reduced unpredictable seasonal variation, it has altered the dominant pattern of flow, reducing the spring peak and increasing flows in summer, when water is required for irrigation and urban water use.

Climate change

Until recently, it seemed reasonable to assume that, despite marked variations over timescales up to a decade, climate was reasonably stable in the long run. However, there is increasingly clear evidence that human activity, including the burning of carbon-based fuels, and the clearance of forests has led to an increase in the atmospheric concentration of greenhouse gases such as carbon dioxide, resulting in anthropogenic climate change, commonly referred to as ‘global warming’.

While it is generally agreed that anthropogenic climate change is taking place, there is little certainty concerning the current and likely future rate of anthropogenic global warming. Even greater uncertainty surrounds effects on rainfall patterns, particularly at the regional level.

Jones at al (2001) project a a decline in winter and spring rainfall by the year 2030. and are uncertain about impacts in summer and autumn. Average temperature, and therefore evaporation, is expected to increase in all areas. The two effects interact, with greater increases in evaporation likely in regions and seasons where rainfall declines.

Demand uncertainty

There is also uncertainty about the demand for water. Agricultural demand for water is a derived demand, ultimately determined by the demand for the products of irrigated agriculture and by the opportunity cost of the best dryland alternative. Given a derived demand curve, and a market in which water rights are freely traded, the quantity demanded by any individual producer will be determined by the market price.

Demand for water for urban use is less predictable, since it depends, to a large extent, on policy decisions. At present, government policy in Victoria prohibits the diversion of water from the Murray catchment to Melbourne, even though the value of water in the urban market (net of pumping, storage, treatment and reticulation costs) is considerably greater than its value in agricultural use. Similarly, although Adelaide draws on the Murray for some of its water supply, there is a considerable gap between the marginal value of water in urban and rural uses.

A change in policy, allowing urban and rural water uses to compete directly in the market, would lead to a significant upward movement in the demand for water. In the policy environment that has existed until now, strong opposition from rural water users has rendered any substantial changes in policy politically infeasible. However, once water rights became fully tradeable, an increase in demand would produce a windfall capital gain for holders of water rights who are willing to sell. It is likely, therefore, that there will be a division of views between rural water users who wish to continue irrigation, and perhaps purchase additional water, and those who are willing sellers. Members of the first group will lose from hgiehr prices while members of the second group will gain. A very similar division has been observed in relation to the conversion of farmland to residential use.

In view of the rapid increase in diversions, prior to the cap, there is little likelihood that, if the price of water is set equal to the marginal cost of diversion, aggregate demand will fall short of total available supply. Hence, the equilibrating process will be one in which the price is determined by the intersection of the demand curve with an upper limit to total extractions imposed by policy. Currently, this limit is set by the Cap, but in future it will be set under the conditions set out in the National Water Initiative.

Policy uncertainty

Policies regarding the provision, allocation and pricing of water for irrigation have varied substantially over time. In general, the policy orientation prior to about 1980 represented a 'developmentalist' approach, in which governments took the lead in constructing and financing irrigation works and set water prices, often below operating costs and almost never at a level that allowed a significant return to capital. As Randall (…) notes, such policies are commonly adopted in the 'expansion' phase of water management systems, when ….

More recently, policies more typically associated with a 'mature' phase of water management have been adopted. These policies reflect the pressures that arise when extractions approach, or exceed, the capacity of the system to supply water on a sustainable basis. This pressure is reflected in conflict between competing water users, increased concerns about adverse environmental effects of water management

Another manifestation or maturity the adoption of techniques such as extraction of groundwater and capture of surface flows, in response to limits on access to in-stream flows. Such actions produce a cycle in which policy responses designed to restrict access to previously unregulated sources prompt a search for less easily accessible, but unregulated, sources, as well as actions designed to exploit weaknesses in the regulatory framework.

In parallel with this process, policymakers and water users are discovering new information about the behaviour of the system under conditions of stress, and are adjusting and refining estimates of likely future water availability in the light of this information. This process has no natural endpoint, but if patterns of use are broadly constant over some period, and climate change is slow and reasonably predictably, the accuracy of such estimates should improve steadily over time.

In this context, policy uncertainty is inevitable. An attempt to fix policy in advance would imply a failure to adapt to new information. The result would be a steadily increasing divergence between a fixed policy position and the optimal response to changed circumstances, leading eventually to the breakdown of the policy, commonly in a costly and chaotic fashion, as with the Reserve Price Scheme for wool.

Some proponents of policy certainty have sought to resolve the problem by specifying, in advance, responses to every conceivable contingency. While contingency planning is often desirable, the idea that policy certainty can be achieved in this way is illusory. Inevitably, contingencies will emerge that have not been adequately anticipated or to which the planned response turns out to be sub-optimal.

The impossibility of eliminating uncertainty

The uncertainties that surround agriculture have produced many proposals for policy interventions aimed at eliminating or mitigating uncertainty. Over time, however, it has been recognised that the complete elimination of uncertainty is neither feasible nor desirable. In the debate on this topic, issues of price uncertainty and climatic uncertainty have been closely intertwined, so it is useful to consider both.

The failure of price stabilsation

In relation to price uncertainty, Hancock (1961, pp. 66-7) summed up the attitudes that prevailed for much of the twentieth century:

> The law which [Australians] understand is the positive law of the State — the democratic State which seeks social justice by the path of

> individual rights. The mechanism of international prices, which signals the world's need from one country to another and invites the nations to produce more of this commodity and less of that, belongs to an entirely different order. It knows no rights, but only necessities. The Australians have never felt disposed to submit to these necessities. They have insisted that their governments must struggle to soften them or elude them or master them.

Governments responded to demand for greater certainty in prices by creating a range of price stablisation and underwriting schemes, of which the most notable was the Reserve Price Scheme for Wool, in which a buffer stock was used to fix a minimum world price for wool. The collapse of the Reserve Price Scheme in 1991, which was followed by years of low prices as the stockpile was gradually sold off, contributed to the abandonment of price stabilisation as a policy goal, and increasing reliance on market instruments.

The abandonment of price stabilisation influenced discussions of public policy in relation to drought and other forms of climatic uncertainty. The main effect was to increase emphasis on methods by which farmers and other water users could plan for, and adapt to, climatic variability and uncertainty, and to discourage attempts to eliminate uncertainty.

Drought policy

Until fairly recently, droughts were viewed as exceptional natural disasters, requiring the application of emergency measures. The traditional approach to drought policy was centred on the administrative policy of `drought declaration' of districts, normally at the discretion of State governments. A variety of relief measures, which varied over time and between states, was made available to farmers in `drought declared' areas. Examples included subsidies for the purchases of fodder, low-interest loans, and cash grants. The implicit policy model was that of an unpredictable natural disaster, like an earthquake. Policy was focused on the provision of assistance to farmers who had suffered, or who were exposed to, losses as a result of drought.

This policy was criticised by economists including Freebairn (1983), who argued that it undermined incentives to prepare appropriately for drought and encouraged practices such as overstocking. Studies of the implementation of drought relief in the 1980s reinforced

Freebairn's arguments and raised new concerns. Only a minority of eligible producers received any relief. In Queensland, 36 per cent of the state had been drought declared every one in three years, and over the period 1984-85 to 1988-89, 40 per cent of relief had gone to 5 per cent of the claimants (Smith, Hutchinson,and McArthur 1992).

The main outcome of the Australian debate was the adoption of the National Drought Policy in 1992. O'Meagher (2003) summarises the key features of the policy.\ Its stated rationale is that `Drought is one of several sources of uncertainty affecting farm businesses and is part of the farmer's normal operating environment. Its effects can be reduced through risk management practices which take all situations into account, including drought and commodity price downturns.' The key policy implication is that `farmers will have to assume greater responsibility for managing the risks arising from climatic variability. This will require the integration of financial and business management with production and resource management to ensure that financial and physical resources of farm businesses are used efficiently.'

The isses surrounding drought policy have been analysed by Quiggin and Chambers (2004) using a graphical version of the state-contingent production model developed by Chambers and Quiggin (2000). Quiggin and Chambers (2004) showed that the anticipated availability fo drought relief would induce farmers to adopt more risky production strategies, such as high stocking rates, and argued that market-based measures, such as rainfall insurance, had the potential to offset risk without distorting production decisions.

Irrigation and 'droughtproofing'

For much of the 20th century, irrigation was presented[1], in combination with relief policies directed at dryland agriculture, as a method of 'droughtproofing' the agricultural sector. The idea is that a guaranteed supply of irrigation water would eliminate reliance on variable natural rainfall, and thereby

As has already been noted, irrigation allows for a more stable flow of water, and for the availability of irrigation water to be used to offset fluctuations in natural flows. Nevertheless, the idea of complete stabilisation, with fully secure water allocations, does not make

[1] Technological solutions, most notably cloud-seeding, were also investigated without success

economic sense, since either water would be under-used in high flow years or investments in storage would be excessive. On the other hand, if farmers design their production strategies to take advantage of high-flow years, they will inevitably incur losses in low flows years.

Many of the ideas put forward in the past were revived by the Farmhand Foundation, established in 2002, which canvassed ideas such as large scale use of piping and reconsideration of the Bradfield scheme. These ideas were subject to vigourous criticism, notably from the Wentworth Group, and the Farmhand chairman recently observed 'While there is no one way to 'drought-proof' Australia, we continue to be reminded the hard way that we live in the driest inhabited country on the planet and that we cannot continue to use water as we have been doing these past two centuries (Farmhand Foundation 2005).

Guarantees of resource access

In the presence of variable and uncertain supplies of water, or other resources, it is natural fo users to seek security of access. It is, of course, possible to guarantee access for some users. However, resource security is, in large measure, a zero-sum commodity. The more security is given to one group of users, the less there is for everybody else.

As will be discussed below, well-defined systems of property rights can help to resolve competing demands for resource security by allowing for a variety of contingent trades in rights. However, accurate definition of property rights is only feasible when the availability of the resource is well understood.

Risk reduction, risk allocation and risk management

Risk and uncertainty cannot be eliminated. But there are a variety of measures for reducing uncertainty, and for managing and allocating risk.

Reducing uncertainty

Uncertainty can be reduced with improved information. In particular, improved methods of weather forecasting can reduce climatic uncertainty. Although there have been significant improvements in short-term forecasting (up to seven days) in recent years, these are of relatively minor importance in the context of irrigated agriculture.

Or more interest are seasonal projections of fluctations associated with the Southern Oscillation (also known as El Nino) and longer-term projections of climate change.

Although the idea of policy certainty is a chimera, uncertainty about policy can be reduced through the adoption of transparent policy process, based on consistent principles. With such processes in place, policy changes arising from short-term political pressures or from the arrival new ministers and other office-holders should be minimised. Policy change should arise primarily as the result of the arrival of unanticipated new information.

To achieve such stability, it is important that the establishment of the policy process should be based on clearly argued principles and should achieve a high degree of consensus. Otherwise, changes in the balance of political power are likely to lead to the reversal of decisions imposed by temporary majorities.

Managing risk

The idea of managing risk is central to modern thinking about uncertainty. It is intuitively obvious that irrigators can adopt strategies that increase or reduce their exposure to particular sources of risk. For example, a farmer whose entire area is planted to high-value crops that are highly sensitive to reductions in the volume of water applied generate a more risky flow of income than those with a mixture of high-value and low-value, more robust crops. Farmers may also employ a range of market-base measures for risk management, such as futures markets and crop insurance.

Although this point is reasonably clear at an intuitive level, it has proved difficult to represent adequately in the context of economic theories of production under uncertainty. The standard approach, based on the concept of a stochastic production function, implies that uncertainty increases linearly with expected output, allowing no real capacity for producers to manage risk.

Chambers and Quiggin (2000) show how a state-contingent representation of production can provide a more realistic representation of active risk management strategies. In addition, this representation allows for an integrated treatment of production-based and market-based risk management strategies (Chambers and Quiggin 2004)

Principles of risk allocation

The central principle of risk allocation is that risk should be allocated to the party best able to manage it. The appealing simplicity of this principle masks some complex and intractable issues however. First, some risks are not easily separated and the party best able to manage one risk may not be able to manage other associated risks so well. Second, as noted by Chambers and Quiggin 2004, risk management has both technological and financial aspects. In many cases, farmers are well placed to manage risk in a technological sense, but have limited acces to financial markets, and can therefore not realise the full value of the risk management techniques at their disposal.

The Murray-Darling and the COAG process

Problems of risk and uncertainty have played a central role in the development of policies for the management of the Murray-Darling Basin. Quiggin (2001) presented a summary of developments in policy for management of the Murray–Darling Basin from Federation to the late 1990s. Environmental problems and competition for water use became evident during the 1970s and acute during the 1980s, signalling the arrival of the mature phase in which the marginal social cost of water use is high and increasing over time.

This process led to the imposition of a limit on aggregate extractions, referred to as the Cap, in 1995. The Cap was the first step in the development of a comprehensive policy response, referred to as the Living Murray Initiative (Murray--Darling Basin Commission 2003). Under the Cap, it was agreed that the total allocation of water from the Murray--Darling Basin would not increase above the level prevailing in 1994. In future, any new allocation to one user would have to be matched by a reduction for some other user.

The need for water allocations to be transferred between users naturally raised the issue of trade. The argument for trade in water rights is simple and appealing. The market would ensure that the aggregate allocation of water could be capped, and ultimately reduced, without imposing high costs on existing water users. Those who placed a high value on water could buy rights from those whose valuation was lower.

The central idea of creating a market for trade in water rights is that rights would be reallocated from low-value uses such as pasture to high-value uses such as fruit and vegetables. Although this reallocation would not, in itself, do anything for the environment, it would reduce the cost and the social and economic dislocation associated with reductions in the aggregate allocation of water.

It rapidly became apparent that this appealing idea was an oversimplification of a complex problem. Water is not a homogeneous commodity. Water in one place, and at one time is not a good substitute for water in another place or at another time. Because it is heavy and bulky, moving water from one place to another or storing it over time is complex and extensive --- this is why irrigation is expensive.

Water is a complex commodity. The structure of rights created by a century of water management is even more so. At the time of the 1994 meeting of the Council of Australian Governments (COAG), few or no water users possessed property rights comparable to titles to land. The closest approximation was a license to take water, typically attached to a particular piece of land. On the other hand, a great many existing and potential users had expectations that water would be available to them.

As a result, the first problem with water trading was to determine who had water rights. A major problem was the emergence of `sleepers' and `dozers'. These were landholders who had water licenses attached to their land, but had never used them (sleepers) or had ceased to use them (dozers). As soon as water became a tradeable commodity, the licenses held by such sleepers became a tradeable commodity. Since extractions from the Murray--Darling Basin were already at or near 100 per cent of natural flows in 1994, it was not possible to allow both the allocation of water to `sleepers' and `dozers' and the continuation of existing allocations to users who did not possess guaranteed rights. With some exceptions, the outcome was that users who had been receiving water under various provisions, but who had no specific entitlement, did not receive tradeable rights, while sleepers' rights were upheld.

The interaction between poorly specified property rights and the unforeseen significance of ‘sleepers’ meant that the policy failed to produce the desired outcomes. In particular, while users who were allocated tradeable water rights benefited from increased certainty, this was more than offset by the greater uncertainty faced by the remaining users, whose collective claims considerably exceeded the available volume of water.

The National Water Initiative

By the end of the 20th century, it was clear that hopes for a rapid transition to a system of fully-tradeabe water rights were misplaced. Many risks and uncertainties remained unresolvde. In this context, a new set of proposals was put forward at the 2003 Council of Australian Governments meeting, which produced an announcement (but not a detailed specification) of a set of policy proposals referred to as the National Water Initiative (Council of Australian Governments 2003).

Two major principles were announced. The first was that, in future, water allocations should be stated as shares of available water, rather than as specific volumes. This approach deals with fluctuations in water availability by sharing the total amount available among users in proportion to their share. It raises the question of whether it will continue to be possible, as at present, to distinguish between high-security and low-security rights. The difficulties with this approach are discussed by Freebairn and Quiggin (2005).

The second principle concerned an approach to the sharing of risk arising from changes in the aggregate availability of water. Under this principle, the risk of changes in water availability due to new knowledge about the hydrological capacity of the system will be borne by users. The risk of reductions in water availability arising from changes in public policy, such as changes in environmental policy, will be borne by the public, and water users will receive compensation for such reductions.

The principles of the National Water Initiative were elaborated in more detail in a statement issued by the 2004 COAG meeting (Council of Australian Governments 2004).\ The Communique specified a framework that assigns the risk of future reductions in water availability as follows: a framework that assigns the risk of future reductions in water availability as follows: –

- reductions arising from natural events such as climate change, drought or bushfire to be borne by water users,
- reductions arising from bona fide improvements in knowledge about water

systems' capacity to sustain particular extraction levels to be borne by water users up to 2014. After 2014, water users to bear this risk for the first three per cent reduction in water allocation, State/Territory and the Australian Government would share (one-third and two-third shares respectively) the risk of reductions of between three per cent and six per cent; State/Territory and the Australian Government would share equally the risk of reductions above six per cent,

- reductions arising from changes in government policy not previously provided for would be borne by governments, and

- where there is voluntary agreement between relevant State or Territory Governments and key stakeholders, a different risk assignment model to the above may be implemented;

The general principles set out in the NWI are consistent with the approach to risk allocation set out above. There are, however, numerous problems to be overcome.

In the short term, the consensus required to implement a policy of this kind was upset when the Commonwealth government announced, in the leadup to the 2004 election, that its contribution to the NWI would be funded by the withdrawal of payments to the states previously made as part of National Competion Policy. The state governments immediately responded by withdrawing from the NWI, though Queensland has since announced its conditional willingness to rejoin. Presumably, these disagreements will be patched up in due course, but the Commonwealth's action was a serious breach of the notions of transparent and predictable policy essential in areas of this kind, and increases the likelihood of more opportunistic policy changes in the future.

A second class of problems relates to implementation. Supposing that long-term averaage rainfall declines in line with the predictions of climate change models. It will be difficult to determine whether the reduction is in fact due to climate change, or merely represents a run of dry years[2]. Although the risk in both cases is supposed to be borne by water users, it is

[2] Resolving this question will not be assisted by the fact that a prominent participant in the debate, the Institute of Public Affairs, is also well-known for its rejection of scientific evidence regarding global warming.

likely that the appropriate response and the resulting allocation of costs between users, will differ.

A more pressing problem relates to the transition from the current set of water rights, which involves serious over-allocation in many catchments, and over-allocation for the system as a whole, to a more sustainable level of use. Quiggin (2004) suggests a possible response, based on the fact that most existing rights are finite in duration, typically with a life of around ten years, but with an expectation of renewal. Rights will be due for renewal and conversion to permanent status around 2014 which also marks the end of the period when risks arising from changes in knowledge about sustainable capacity are borne entirely by users. Quiggin (2004) suggests that the adjustment path could be eased, and risk reduced, if governments offered to repurchase renewal rights or, equivalently, make a cash payment to growers in return for conversion of their existing rights into fixed-term rights, with no option of renewal.

Concluding comments

As new knowledge about water systems emerges and new demands, such as increased concerns about environmental flows, arise, policies must adjust. The adjustment process inevitably creates uncertainty for both new and existing water users. It follows that the allocation of risk and uncertainty is a crucial problem in the design of institutions for water management in Australia.

Risk can not be eliminated but it can be managed. Improvements in risk allocation have the potential to yield substantial improvements in welfare. The National Water Initiative is a promise start, but much more remains to be done.

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