
Volume 29, Issue 2 May 2010
ISSN 1449-4035
ELSEVIER
policy and society
An Interdisciplinary Journal of Policy Research
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Policy and Society 29 (2010) 171–180

policy and society

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Water policy—Evidence, learning and the governance of uncertainty

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Abstract

The evidence-based policy (EBP) movement has often focused on relatively stable policy issues and service programs where rigorous analysis has been able to enhance policy-makers' consideration of improvement options. However, EBP has taken different turns in policy fields marked by value-conflict, rapid change, high risk or radical uncertainty. One such area in recent years has been water policy, in the context of water scarcity. There have been urgent new challenges for water policy, planning and delivery in many cities and regions around the world. This paper examines an Australian case-study, the urban water crisis in Southeast Queensland (SEQ), taking a policy governance perspective. The State government became increasingly alarmed by the deteriorating water-supply outlook, and undertook a number of policy changes including substantial re-structuring of urban water governance. The paper raises issues about the evidence base for decision-making, and for policy learning, where policy governance is shaped under conditions of uncertainty and crisis.

The evidence-based policy (EBP) movement has sought to promote rigorous analysis of service programs and policy options, thereby providing useful inputs for policy-makers in their ongoing consideration of policy development and program improvement. There are differences across policy domains in how the knowledge/policy nexus has operated. Many of the EBP focus-areas that have been most strongly advanced and valued have been in social welfare, education and healthcare services (e.g. see Coalition for Evidence-Based Policy, 2009; Nutley, Walter, & Davies, 2007). Here, fruitful synergies have developed over time between (a) the policy and program managers actively considering cost-effective improvements, and (b) researchers who can supply rigorous analysis of recent experience and careful assessment of future options. In such areas of service delivery with a degree of stability and continuity, there may be a reasonable prospect of cumulative understanding of trends, causes and impacts. The expectation emerges, among both policy managers and researchers, that better information, rigorous analysis, improved implementation, and continuous evaluation will gradually enhance the quality of programs, with corresponding benefits for clients. But in other policy areas, such as the rapidly evolving challenges in sustainability and natural resources management, there are sometimes serious disjunctions between evolving issues, knowledge bases, and institutional capacity for measured responses.

In general, the capacity to provide rigorous analysis and well-costed options depends on the availability of good *information*, funding to ensure the *analytical capacity* needed to assess existing and alternative options, and the *strategic capacity* to consider pathways beyond business-as-usual. These conditions are more likely to prevail in political and institutional contexts that value transparency and consultation, and that facilitate adaptive responses to issues.

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1449-4035/$ – see front matter
doi:10.1016/j.polsoc.2010.03.007

1. Approaches to policy governance

Good information and sound analytical capacity are vital for understanding past experiences with program interventions; for drawing lessons about what works and why; and for analysing and costing future policy options. Government agencies make major investments in both information collection and in the analytical skills required for monitoring, evaluation, and advice. From the perspective of government agencies preoccupied with routine or everyday accountability for performance, most of the key *information* is concerned with monitoring *government program activities* (i.e. officially endorsed service delivery actions and associated budget expenses). But from a broader perspective, other types of information are also important for understanding the evolving nature of problems and responding effectively to them (Head, 2008a). These include:

- the professional perspectives and experience of organisational partners, whether public sector agencies or non-government organisations (NGOs), in areas where responsibility is shared for delivering services or for achieving targets and standards;
- the experience and viewpoints of business, households, and service clients directly affected by the problems and programs under consideration; without this dimension there is little basis for claiming to provide client-focused services;
- consideration of underlying trends and possible *future scenarios* (Schwartz, 1991) that can be constructed and discerned though various methods of 'prospective' analysis (Godet, 1994), using pools of diverse expertise to broaden the range of inputs towards new thinking. These techniques go beyond what are usually included in 'evidence-based' analysis, but may be especially relevant in fast-moving areas characterised by the need for strategic responses to potential large risks in the face of incomplete and uncertain knowledge.

Thus, it is useful to distinguish between policy and program issues that are managed through ongoing processes of minor adjustments and fine-tuning, and policy issues that require major reconsideration of strategy in the face of actual or potential changes in circumstances. The first group of policy issues – hopefully the majority of government business – tend to be managed through standard planning, implementation and monitoring processes, on the assumption that there will be a reasonable degree of continuity and stability. This approach is consistent with the rationalist assumption of cumulative wisdom and fits with managerial aspirations for tight program plans and close controls over outcomes.

The second group of policy issues are more turbulent and difficult to pin down. They are characterised by incomplete or uncertain knowledge, changing conceptions about the underlying problems, competing values and perspectives, and rapid shifts in policy frameworks. At the far end of this spectrum, issues can become intractable and incapable of being 'solved'—these are sometimes called 'wicked' problems, which can at best be settled politically on a temporary basis but remain as enduring challenges (Head, 2008b; Weber & Khademian, 2008).

Issues that seemed to be relatively stable for long periods can move across into the second group as a result of rapid shifts in circumstances. These issues become marked by political conflict, policy debates on several fronts, and disruption to established institutional arrangements. During recent decades, water has become such a policy arena in many developed countries (e.g. Pahl-Wostl, 2008).

2. Water as a policy issue

During the past century, the supply of good quality water for agricultural, industrial and household uses has been seen as essential for meeting the twin goals of economic development and human public health. Water supply projects and systems were designed and managed by technical experts, within the policy domain of physical infrastructure. The planning and construction of large water storages and distribution networks was the province of water engineers and hydrologists. Financing expensive water infrastructure remained a challenge, but the capital costs were regarded as a government responsibility in most countries. The other main constraint centred on the limited and diminishing availability of sites for building water storages, regarded as necessary to meet ever-higher water consumption driven by population expansion and industrial development.

In recent decades, the technology paradigm that had traditionally governed water issues has become entwined with more complex issues of ecological and resource sustainability. Although competition for accessing scarce water resources has a long history, the conflicting demands of agriculture, heavy industries, urban households and the ecological needs of waterways and biodiversity have become more intense and more keenly contested. As the scientific evidence and professional experience of environmental degradation of waterways became more compelling, there were corresponding shifts in the perceived policy problems demanding attention. Problems were exacerbated by a decline in water availability in some regions, as a result of both over-extraction and changes in rainfall patterns. Pressures arose for new strategic directions, focusing on demand-management, water efficiency, and collective frameworks that would allow burden-sharing and trade-offs among stakeholder interests. These factors have highlighted the social and institutional aspects of water policy and management (Blomquist, Heikkila, & Schlager, 2004; Colebatch, 2006; Lach, Rayner, & Ingram, 2005).

In developed countries, the need to promote resource sustainability, the need to manage the conflicts arising from multiple stakeholder interests, and the need to negotiate durable agreements across jurisdictional boundaries, have reshaped the institutional arrangements for water-related policy. Whether in Europe (e.g. European Commission, 2000, 2009; Kissling-Naf & Kuks, 2004; Van der Brugge & Rotmans, 2007), Canada (e.g. Bakker, 2007), the USA (e.g. Sabatier et al., 2005; Scholz & Stiftel, 2005), or Australia (e.g. Dovers & Wild River, 2003; Pigram, 2007; Troy, 2008), water policy has become a complex policy domain. Water engineering and technical innovation have remained a necessary but not sufficient focus for problem-solving. The technologies for water capture, storage, purification, distribution, and monitoring remain fundamental; for example, technical innovation will continue to be essential for improved water conservation and recycling systems into the future. However, the policy system has shifted towards recognising the contributions of a broader range of expertise, and recognising the advantages of inducing cooperative behaviour by stakeholder groups. Stakeholder networks and stakeholder expertise have become crucial for achieving politically feasible outcomes in water management (Griffin, 1999; Freeman, 2000), by reducing conflict and allowing a greater role for consensus formation in the policy system (Connick & Innes, 2001).

The new policy agendas, informed by broad scientific analysis, have required new ways of framing the problems (Gleick, 2000; UNESCO, 2009), with more attention to intersecting issues (e.g. those linked to environmental regulation, land-use planning, conservation biology, chemical pollution, civic trust in science, political leadership, and multi-level governance). In this search for broader understanding, a much wider range of expertise has become relevant. In terms of scientific and policy-relevant knowledge, new areas of inquiry and evidence have been developed to inform decision-making, and corresponding new capacities developed for data collection and complex information analysis. And as the policy governance arrangements became more complex, new needs emerged for cross-organisational collaboration, both across government agencies, and between the business, scientific, community and government sectors. Table 1 outlines some of these knowledge-linked changes in a schematic and simplified form.

Water policy and management in recent years have been confronted with significant challenges arising from the simultaneous need to address climatic variation, eco-system health, competing interests, institutional change, and the introduction of new regulatory approaches including market-based systems. The traditional engineering paradigm of the previous century had focused on the construction of physical infrastructure to ensure water security for business and household consumers. However, in the era of ecological sustainability, it became increasingly accepted that a small group of experts drawn from just one discipline could not resolve the complex issues of planning, designing and financing all the measures required for sustainable water usage, waterway quality, and diversification of water supplies. The traditional engineering approach has been challenged and supplanted in most countries by strategic frameworks that place long-term ecological sustainability at the centre of policy governance (Allan, Curtis, Stankey, & Shindler, 2008; Gleick, 2000; Hussey & Dovers, 2007; Kissling-Naf & Kuks, 2004; Lach et al., 2005; UNESCO, 2009; Van der Brugge & Rotmans, 2007).

Table 1
Water management styles—traditional and future.

1970s	2001 and beyond
• Singular problem	• Inter-related problems
• Locality-based technical planning	• System-based spatial planning
• Solve today's problem	• Anticipate tomorrow's problems
• Disciplinary professional skills	• Interdisciplinary professional skills
• Engineers	• Engineers, biologists, public managers, spatial planners, etc.
• Hierarchical, top-down	• Networks, participation

Source: Adapted from Van der Brugge and Rotmans (2007: 261).

Table 2
Expected features of integrated and adaptive regimes.

Dimension	Integrated and adaptive regime features
Management paradigm	Management as learning in complex adaptive systems
Governance style	Polycentric, horizontal, broad stakeholder participation
Sectoral integration	Cross-sectoral analysis identifies emergent problems and integrates policy implementation responses
Scale of analysis and operation	Trans-boundary issues addressed by multiple scales of analysis and management
Information management	Comprehensive understanding achieved by open, shared information sources that fill gaps and facilitate integration
Infrastructure	Appropriate scale, decentralised, diverse sources of design, adapted to regional context
Finances and risk	Financial resources diversified using a broad set of private and public financial instruments, and future risk strategies to be informed by public discussion

Source: based on Pahl-Wostl (2008: 9–11).

Capacity for adaptive change, by both decision-makers and water users, has become as important as the technical and financial capacity to build and maintain large infrastructure systems. As noted by Pahl-Wostl (2008), the need for more integrated and adaptive approaches to water resource policy has become clear. But there is insufficient evidence and experience on which to base reliable prescriptions about the kind of governance regimes needed for integrated and adaptive management. Nevertheless, a number of likely requirements can be suggested, as outlined in Table 2.

These features of a more integrated and adaptive approach to water management include some aspirational and prospective elements. Thus, the evidence base for these institutional arrangements will itself remain uncertain and will need to allow for substantial institutional variations in different situations. Under the conditions of transition from a traditional technical paradigm towards a more adaptive and multi-disciplinary paradigm for water governance, the scope for drawing on a rigorous and agreed foundation of research – as the basis for compelling evidence-based advice on policy options – remains limited. During the next few years, pending a stabilisation of values and processes around a new system, the water policy domain will remain open to the unpredictable influence of stakeholder interests and of political leaders' judgements concerning how to define the problems and how to allocate responsibilities for problem-solving. The scope for innovation and for learning will therefore vary widely across different contexts. In order to explore these trends and issues, this paper briefly analyses a regional case-study in Australia.

3. Case-study: water policy in Southeast Queensland

3.1. Water policy in Australia

Water policy in the Australian federation involves three levels of government—the national government, six state and two territory governments, and around 600 local authorities. Until the 1980s the national government was only a minor player in water policy, but has gradually become more involved through its success in steering new national policy agreements and by providing financial incentives to encourage water reform by the states. The state and territory governments have the major role in water planning and bulk storages, while local authorities have usually managed the water distribution and retailing functions, except where the states have established large metropolitan statutory authorities for water supply. Issues of water policy and regulation in Australia have historically been centred on major river systems and their capacity to provide both irrigation water for rural industries and urban water for residential and industrial users (Pigram, 2007). Except in the tropical north, several regions have had long histories of rainfall variability, including drought conditions for extended periods. Much of the policy effort by state and national governments has therefore been directed at rural water issues based on major inland waterways, such as the Murray-Darling river system. But the recent long drought after 2001 also placed major new stresses on urban water supplies, leading to a perceived crisis in water planning and a serious debate about how to ensure long-term urban water security.

The national government has played a decisive strategic role in brokering three major inter-governmental agreements on water policy, in response to historical problems of over-allocation of water extraction licences in river systems, and the negative impacts on biodiversity and river health arising from low flows. The first inter-governmental agreement in 1994 required all governments to undertake more systematic appraisals of water resources at a regional catchment level, and to introduce measures for water efficiency and conservation, especially the introduction of user-pays pricing for water across all sectors (Australian Government, 1994). The second agreement in 2004 extended these principles, and also established a National Water Commission to advise on progress in implementation of the action plans and to further examine the issues of urban water supplies and usage (Australian Government, 2004). The third agreement in 2008 established a national Authority to oversight the complex water planning issues for the Murray-Darling basin (Australian Government, 2008), replacing a long-standing multi-jurisdictional body that had failed to grasp the challenges and tough political choices during its 30 years of cooperative deliberations (Connell, 2007).

In short, the issues of water policy and planning have intensified in the most recent decade as the long drought forced a reconsideration of a complex multi-faceted crisis—lower average rainfall linked to climate shifts; over-allocation of irrigation water entitlements; increasing population in major cities; and concerns about river health stemming from low flows in river systems (Young, 2007). Water for major cities has remained mainly the concern of state governments, although subject to increasing pressures from the national government regarding the need to improve the economic efficiency of state-owned water utilities.

3.2. Water policy in Southeast Queensland—an overview

The region of Southeast Queensland (SEQ), which includes Queensland's state capital city of Brisbane, covers 22,000 km^2, about the same size as Denmark. The region contains nearly three million residents across 12 local government areas, including Brisbane City (a very large integrated local authority) and 11 smaller local government bodies. The waterways of SEQ drain towards the east coast, and have therefore not been drawn into the major national conflicts over rural irrigation practices that have marked the debates about the Murray-Darling basin waterways. Nevertheless the water issues in SEQ have many features in common with those of other coastal regions in Australia.

The recent history of water policy, planning and delivery in SEQ may be divided into several phases. Until the 1980s the standard approach was to construct adequate water-supply storages for rural and urban uses, making use of historical rainfall data and projecting steady increases in population. Water engineers and political leaders were broadly aligned in this approach, despite occasional public controversy around where to locate particular storages. After the 1974 cyclone produced major flooding in coastal SEQ, the focus of political and professional attention shifted to flood mitigation infrastructure, and a major dam (Wivenhoe) was built primarily for this purpose in the early 1980s. The illusion that SEQ had abundant water was reflected in water metering practices. In Brisbane, for example, the proportion of properties with water meters was very low in the period through to the late 1980s when fewer than 10 per cent of households had information about their water consumption levels.

During the 1980s and 1990s, a second approach began to overlay the traditional engineering approach. Movements for 'integrated catchment management' and 'Landcare' emerged, with government financial support, to promote better land management practices by land-holders in many catchments or river basins. These initiatives became linked with broader interests in ecological sustainability, accelerated by growing political and scientific attention to the ecological health of urban waterways. In a short time the issues of chemical pollution and nutrient loads in urban rivers, bays and estuaries, with their implications for human health and aquatic biodiversity, became major matters of public concern. A broad coalition of environmental groups emerged in the 1980s and 1990s, calling for a clean-up of waterways and focusing on water quality rather than quantity.

These demands for clean catchments and waterways were channelled into the environmental objectives of the SEQ regional planning framework that was being developed in the mid-1990s. This framework was supported politically through an alliance of local councils, environment groups and scientists—known later as the Healthy Waterways Partnership (see HWP, 2007). With funding and policy support from the State and federal government, this alliance achieved the upgrade of 25 sewerage treatment plants to reduce pollution in rivers and coastal waters. Having achieved this objective, they turned their attention to other forms of water pollution, especially from industrial waste discharges and chemical runoff from farmlands. An annual ranking of river water quality by the Waterways Partnership became a powerful instrument of public audit. Legislative changes reinforced these new directions, with a new Queensland Water Act in 2000, partly motivated by the state's obligations under the national water agreement. 'Water resource plans' were henceforth mandated for each catchment, requiring scientific input and consultative processes for assessing future water availability and any implications for further development, taking account of projected water flows and the respective needs of rural industries, urban industries and residential consumption. This legislation also provided the foundation for gradually moving towards implementing the cost-efficiency and user-pays principles of the national water agreement and the National Competition Policy.

A third period commenced with the emergence of the long drought in 2001. Apart from occasional supply problems leading to restrictions on water-sprinkling for suburban gardens, there had been little urgency previously accorded to major urban water supplies. The supply-side problems were beginning to become evident owing to a combination of fast-growing population (which was already factored into water planning forecasts) and an unpredicted shift towards drastically lower rainfall patterns from 2001.

3.3. Dams and other options for SEQ

The water crisis of 2001–2008 placed decision-makers under increasing political pressure, since SEQ was not well prepared for the contingencies of a substantial drought, and risk management for prolonged low rainfall in the catchments was minimal (Spearritt & Head, 2010). At the worst point of the drought the major water storages for SEQ fell to around 17 per cent of capacity, and decision-makers became preoccupied with the need for rapid solutions. The water bureaucrats began to publish more detailed scenarios based on lower rainfall projections as a basis for attracting the strategic attention of leaders (Queensland Government, 2004, 2005). Water professionals in the state bureaucracy who were supportive of building more dams had been consistently overlooked by state political leaders in the period from 1989 until about 2006. The water planning and delivery system for SEQ in the decades prior to 2006 had operated as a complex set of shared functions between local and state bodies, but with a lack of clarity about who was ultimately accountable for water investment and water policy leadership. Conflict between state and local leaders was exacerbated by the election of a dynamic conservative Mayor in the City of Brisbane, who clashed on many issues with the Labor state administration. The cooperative and devolved arrangements for water planning came under pressure as the urban water crisis deepened. The state and local authorities became increasingly alarmed by the deteriorating water-supply outlook but a joint solution seemed out of reach at the political level.

In 2006 the state government commenced a series of major changes. First, it established a Queensland Water Commission in 2006 to re-centralise water strategy responsibilities. Secondly, the government promised to build major new storage and pipeline infrastructure—a new dam at Traveston (beyond the northern boundary of the SEQ region) plus a pipeline grid network to facilitate transfers between storages and across catchments. Thirdly, in the following year the state took further steps to centralise water governance by taking control of all public water infrastructure, largely eliminating local government roles in water supply other than in retailing. Fourthly, it commenced a major investment program in new supply-side options to supplement reservoirs, including a potable recycled water facility and a desalination plant. Finally, it fostered a range of demand-management and water conservation measures, primarily directed at households, including a much lower water consumption target (140 litres per capita, which was half the 'normal' average); subsidies for domestic rainwater tanks; and subsidies for water-efficient household fittings. These targets and incentives proved to be very effective in changing consumer behaviour. Thus, there were multiple responses to the crisis—policy innovation, organisational re-structuring, new legislation, behavioural incentives, and expensive new infrastructure. Some of the supply-side and demand-side options are summarised in Table 3.

The basis for making decisions among the available options for pursuing water security and water sustainability had necessarily involved complex technical issues and complex economic modeling. The choices were not straightforward, given (a) the uncertain evidence about rainwater availability, (b) the uncertain effectiveness of incentives and targets in influencing behavioural change, (c) the political sensitivity of using price increases as a

Table 3
Responses to the water crisis.

Supply-side responses (i.e. establishing alternative and supplementary water supplies)	Demand-side responses (i.e. reducing water consumption through demand-management measures)
• Desalination plant	• Restrictions on certain water uses
• Wastewater purification plant (recycled water facility)	• Installation of water-efficient devices
• Build new dams	• Water metering
• Increase capacity of existing dams	• Higher prices for water
• 'Water grid' pipelines	• Consumption targets for localities and/or major users
• Acquifer recharge if feasible	• Information, education and publicity
• Stormwater capture for industrial re-use	
• Incentives for domestic rainwater tanks	

regulatory tool, and (d) the prospect of winners and losers, and difficult trade-offs affecting the interests of stakeholders. Under these conditions, political leaders were wary about sharing all their thinking and all their data with the general population. Technical reports from consultants were commissioned to fill gaps and provide sound advice, but the economic cost/benefit models used to calculate choices were not evident. Analysts outside SEQ had examined a wide range of options both for water saving and for water production, and found huge differences both in their relative cost and in their likely impact on the magnitude of the problems. For example, Young (2007: 91) showed that potential costs per kilolitre ranged from less than 50 cents to more than five dollars; and that the quantities saved or produced ranged from very small volumes (e.g. rainwater tank incentives) to substantial volumes (e.g. major infrastructure such as recycled water plants, desalination plants, inter-regional pipelines). Ultimately the state government opted for a suite of options, responding to a range of advice, taking a broad approach to risk management, and being mindful of the political need to gain support through effective communication with citizens and industry water users.

3.4. After the crisis?

A draft SEQ *Water Strategy*, first published in March 2008 at the height of the crisis (QWC, 2008), remained unfinished while the changing context for decision-making was being further assessed and implementation of key decisions was being completed. Ironically, once the main planks of the new arrangements had been implemented, 'normal' summer rainfall resumed in late 2008 and again in late 2009, to the great relief of decision-makers and citizens alike. This break in the drought led to significant changes and reversals. Subsidies for domestic rainwater tanks were withdrawn, and household consumption targets were eased. Importantly, potable recycled water from the expensive new treatment facility was not introduced into reservoirs (owing to perceived consumer resistance), but was instead made available for industrial users (and with some considerable difficulties in relation to cost-recovery). It was announced that the previous policy of introducing potable recycled water into reservoirs would lie dormant, to be reconsidered if the dam levels again fell below 40 per cent of capacity. Additionally, when the federal government surprisingly vetoed the proposed new Traveston dam on environmental grounds in October 2009, the state government proposed that additional desalination plants would have to be brought forward to address the supply gap. A further draft strategy, embodying these modifications, was released for comment in November 2009 (QWC, 2009).

4. Evidence, learning and policy choices

The case-study raises a number of key issues about the evidence base for policy governance and decision-making under conditions of uncertainty and crisis. There are also some important implications for how and whether learning opportunities are recognised and taken up by decision-makers and stakeholders.

Firstly, it was widely agreed that the evidence base for water planning had to be seriously revised. Historical evidence about average rainfall and inflows into water storages had been called into question by an emerging pattern that seemed quite different (Queensland Government, 2004, 2005). As a result of the water crisis and associated debates about climate change and increased variability of rainfall, the water professionals agreed that historical patterns had become an unreliable guide to predicting future patterns. Some argued for higher investment in meteorological modeling in the hope of increasing the reliability of rainfall forecasting; others advocated more dams and pipelines; others opted for new technologies for purifying and recycling stormwater and sewerage water. The outcome was that water resources were to be managed on the basis of best-available forecasting data but combined with a broad combination of supply-side and demand-side strategies which, it was hoped, would provide managers with an enhanced capacity to manage risks and cope with uncertainty.

Secondly, the evidence base for this revised multi-layered approach to water policy remained fragmented, with significant gaps in knowledge. The revised approach was politically defensible, but there was limited field experience on which to draw in SEQ and other regions. Water professionals were mindful of recent experience that the scientific capacity for forecasting key variables remained limited, as demonstrated in the drought of 2001–2008. There was little evidence from other jurisdictions, whether in Australia or internationally, that could fill these gaps. For example, uncertainties arose from lack of experience about how consumers would respond to different situations of water stress, including their acceptance of low targets and their willingness to drink recycled or purified water. Other uncertainties arose from lack of reliable economic modeling about how prices might shift in response to water scarcity, including the need to absorb the costs of expensive new infrastructure and energy-intensive methods of water production and distribution. Other gaps in knowledge concerned whether market incentives could expedite the development of affordable technical solutions to address the water-efficiency needs of both rural and urban industries (the largest water users), and whether regulatory arrangements for urban planning and industrial development could encourage water recovery and recycling schemes at a local scale. Evidence was mobilized by stakeholders to bolster arguments in favour of their preferred options, with little consolidation around a 'scientific consensus'.

Thirdly, the nature of the water policy challenge had broadened over time from being largely the province of engineers (hydrology and infrastructure construction) towards broader and diverse issues—environmental sustainability, the economics of water regulation, competing water uses, and shifts in consumer and industry behaviour (UNESCO, 2009). Complex debates over appropriate trade-offs between ecological, residential, agricultural and industrial uses of water raised fundamental issues about policy processes in a democratic society, which could not reasonably be resolved by engineers alone. The crisis had demonstrated to the scientific research community a need for drawing on a wide range of knowledge and for broad cooperation between various types of scientific expertise and stakeholder interests, as anticipated in the European research literature (e.g. Berkes, 2009; Pahl-Wostl, 2008; Van der Brugge & Rotmans, 2007). However, in this case-study, political pressure to find rapid solutions proved to be unfriendly to open dialogue and to inclusive debate on long-term directions. The crisis provoked calls for decisive political leadership and expert-driven advice, in response to increased civic anxiety and polarised public commentary.

Fourthly, the state/local cooperative models for water planning that had operated in the late 1980s and through the 1990s became discredited around 2004–2006 as the prolonged drought deepened, and as state/local conflict emerged at the political level. The state government concluded that planning responsibilities had become unclear, local authorities were too weak or fragmented, and that centralisation of authority was necessary. In 2006–2007 the state government replaced the previous devolved system with a statutory authority model which concentrated full planning powers over water security and water assets in relation to any region as determined by the state government. Former allies within local government and regional planning partnerships became distanced from core decision-making. Thus, the role of local government in water issues was severely reduced, leading to a higher (though perhaps temporary) level of political distrust and conflict. Moreover, the water quality agenda championed by the Healthy Waterways Partnership was side-lined while the water supply crisis was given top priority. Governmental commitment to broad sustainability strategies remained in place (e.g. endorsing the principles of integrated water management and sustainable resource development), but the means for pursuing and achieving such goals were changing and the integrative perspective had no clear voice.

Fifthly, the crisis led to the state government focusing on rapid development of a credible response strategy, and then a strong technical and administrative focus on implementing its key elements. Other issues became side-lined, as attention focused on these selected priorities. The key immediate challenges were to implement the new centralised business model for water assets, and simultaneously to implement the extensive package of supply-side and demand-side measures. Broad sustainability goals were redefined in the form of water security goals. The range of policy choices considered was initially very wide but was quickly focused on clusters of policies regarded as immediately deliverable and thus more useful than others. Moreover, while one contentious (and perhaps courageous) policy was announced in relation to potable recycled water, other conservation options were firmly ruled out, especially the argument by environmental consultants (ISF, 2007) that a concerted program of water conservation and water efficiency could have deferred the need for expensive new water infrastructure—this argument was rejected in favour of infrastructure options. Time will tell as to whether this flexible package of measures becomes the new 'business-as-usual' model for SEQ for the long-term, and whether more decentralised options (such as localized stormwater harvesting and recycling) will become added to the mix.

Sixthly, this case-study casts doubt on the emergence of cooperative learning outcomes that have been much examined and admired in natural resource management networks (e.g. Berkes, 2009; HWP, 2007; Keen, Brown, & Dyball, 2005; Pahl-Wostl, 2008; Sabatier et al., 2005; Schusler, Decker, & Pfeffer, 2003). This case-study suggests that cooperative learning – across stakeholders, experts and decision-makers – is highly context-dependent, and does not emerge in all issue-areas. Cooperative learning may be variously seen as a process goal, a process outcome, or both. In this case, cooperative learning was difficult to pursue when policy was in flux, political stakes were high, and there were institutional winners and losers. Importantly, there may be 'stages' in the policy learning process, such that the learning opportunities arise at different points in the policy cycle. Thus, learning opportunities may be episodic rather than continuous.

In this case, the policy and knowledge 'lessons' drawn by various stakeholders varied considerably, and continued to be reflected in ecological and economic debate. In a context of low trust between some stakeholders, with competing viewpoints linked to power and authority differences, cooperation retreated to the safety of informal and professional networks. Reasoned discussion of future directions and long-term pathways can be resumed as an inclusive process when the locus of responsibility for decision-making is not under challenge. In this case-study, the crisis period concentrated political authority and focused attention on implementing the new arrangements. Hence the opportunity for engaging in broader dialogue and knowledge-sharing may have to await a more settled period as the new paradigm becomes stabilised. Many issues are likely to require medium-term debate and experimentation before the shape of a new paradigm for water governance is stabilised and perhaps routinised.

Acknowledgements

The author appreciates comments from this journal's reviewers and from many colleagues at conferences in Potsdam, Brisbane, Canberra and Copenhagen during 2007–2009 where earlier versions of these ideas were presented.

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