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Role of hydrology and economics in water management policy under increasing uncertainty

A. Loch [a,*], D. Adamson [b], T. Mallawaarachchi [b]

[a] CRMA, School of Commerce, University of South Australia, GPO Box 2471, Adelaide, SA 5000, Australia
[b] RSMG, School of Economics, University of Queensland, Brisbane, QLD 4072, Australia

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ABSTRACT

Well-designed public policy stimulates social progress. However, when governments translate political vision into programmes for social change, the complexity of issues can overwhelm the policy-making process, creating disappointment and suboptimal outcomes. In this paper we examine why evidence-based policy-making approaches often fail to provide policy-makers with credible, consistent and clear outcomes matching broad social interest. The need for public policy primarily arises from a lack of perfect knowledge, which causes individuals and agencies to behave in ways that counter social interest. We therefore suggest that effective public policy formulation involves: determining what evidence is available, relevant and useful; as well as identifying critical gaps to making public policy necessary and meaningful. Murray-Darling Basin case examples highlight key stages in effective natural resource policy formulation, and sources of difficulties that need to be managed to maximize scientific contributions. These examples show that effective public policy decisions can still be made and information asymmetry managed via strong evidence, expert analysis to verify that evidence, and an understanding of knowledge gaps such that critical interventions can be agreed upon and objectives achieved in view of how they will be managed and resourced. Finally, we draw attention to the opportunities available and challenges that exist for hydrologists, economists and other social scientists to work together in assisting the policy process, and in particular to minimize the burden of information constraints in making effective water resource policy.

1. Introduction

Among other things, the need for policy arises due to uncertainty in the processes governing society, while the purpose of public policy is to improve social welfare. Governments generally achieve improved social welfare by selecting certain courses of action over others from a consideration of the relevant benefits and costs associated with alternatives. Since the 1990s, there has been increasing recognition that the problem of social choice may be better served through improved scientific input to policy development (OECD, 2002). Acceptance of this logic has resulted in mainstreamed policy-making, where prior internalized government choices have transformed to pluralistic processes involving wider external engagement (e.g. consultation). The pursuit of a scientific approach to policy development dates back to the enlightenment era, but its modern expression, the rational model of decision-making, owes to the seminal work of Herbert Simon (1947) that probed the logic and psychology of human choice. Simon further developed this to form the modern theory of organization (Simon, 1976). The approaches took root in environmental policy-making, and collaborative governance now dominates a broad range of policy areas where uncertainty features prominently as the primary policy concern (Escobar, 2013). This transformation is well demonstrated by the public discourse associated with development of the Murray-Darling Basin (MDB) Plan (MDBA, 2012).

However, in the absence of an established policy science, policy-making remains a craft that brings together existing knowledge (evidence) from various fields to blend diverse interests and opinion with political ideals. In the arena of Australian water policy for example, expert hydrologists, economists and other specialists have provided advice and technical inputs to improve policy design and function. Social input to the policy reform process has typically been achieved through consultation among relevant stakeholders (Crase et al., 2013). Arguably, much of the resultant policy reform has been beneficial and representative of world's best practice (National Water Commission, 2012; Quiggin et al., 2012). The policies so crafted work broadly within existing legal frameworks underpinned by the Australian Constitution to define individual and

* Corresponding author. Tel.: +61 8 8302 7296; fax: +61 8 8302 7001.
E-mail addresses: adam.loch@unisa.edu.au (A. Loch), d.adamson@uq.edu.au (D. Adamson), t.mallawaarachchi@uq.edu.au (T. Mallawaarachchi).

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group choice sets, thereby influencing how firms and individuals make decisions that collectively impact on society. [1]The aim of this paper is to identify critical issues surrounding practical water resource public policy, particularly in relation to hydrological realities and economic aspirations. Using the MDB for representative examples we draw attention to the opportunities available, and challenges that exist, for hydrologists and economists to work together in assisting the policy process; in particular to manage the burden of information constraints in the formulation of effective water resource policy. We also examine the benefits of modeling as a means to inform choices for water managers within hydrological or ecological constraints, including risk, ambiguity and uncertainty.

Our discussion demonstrates that, despite improved scientific input, policy formulation remains a suboptimal activity; the evidence-policy relationship is not as clear-cut as its advocates might expect (Banks, 2009). However, we contend that effective policy formulation can be achieved by systematically reducing information asymmetry via strong evidence, expert analysis to verify that evidence, and an understanding of knowledge gaps. We reflect on specific water policy formulation complexity where resources flow across political boundaries, are highly variable in nature, and where the aspirations of resource users and beneficiaries are diverse. Complexity usually arises from uncertainties about how numerous parts of an entity interact. In relation to society, future needs drawn from the environment through economic activities, as well as various climatic states that govern capacity to meet those needs, determine the way we manage the environment. [2]From a hydrologic and economic viewpoint, the nature of our choice sets and how we achieve chosen outcomes are too complex to track through mere simple-system cause-and-effect relationships. When formulating policy interventions in complex systems it is imperative to develop robust and agreed foundations on critical intervention paths toward chosen social welfare objectives, with clear comprehension of societal capacity to fund and manage such objectives.

2. The science–policy relationship

2.1. Policy problem

Policies set by governments, social norms, customs or personal values affect how people interact with one another and with their broader surroundings. They do so by allocating rights to resources (property rights); defining incentives for social participation (market mechanisms); controlling the way resources are used (regulations) and how rewards of resource ownership and use are shared amongst members of society (subsidies and taxes). Conventional economic wisdom suggests that the allocation and rewards from resource use in society can be primarily coordinated through markets, and that claims for changed resource-use rules must be linked to market failure. Market failure typically arises from externalities. Important sources of externality impacts around the allocation of public goods include: uncertainty; new information or social preferences; and technology changes that highlight such externalities. It is difficult to argue, however—despite their strong influence in the make-up of modern society—that markets drive all decisions of society and that therefore all social ills are the result of market failure (Bromley, 2007). It is easier to argue that a role of public policy is to address these issues. The policy problem involves difficult trade-offs in the reassignment of existing rights (changing the present) and the formulation of appropriate incentives to achieve behavioral change that results in more efficient resource use. Policy-makers therefore need an analytical process to judge the merits of proposed changes against the status quo, which considers the gains and losses to affected parties. This prompts the introduction of our first MDB example (See Fig. 1).

The recent thrust for MDB water policy and institutional change (aside from periodic drought events following federation) can be traced back as far as the late 1960s. Prior to this, MDB policy sought to enhance production benefits from water use (Cummins and Watson, 2012). However, increasing awareness of environmental negative externality impacts from over-allocating water caused governments to expand the mandate of MDB authorities to take a stronger role in environmental management (MDBC, 2007). This, among other issues, led some Basin states to place moratoria on the granting of further consumptive (production) extraction rights (Loch et al., 2013). In this example, a public good problem existed: widespread environmental concerns including increasing river salinity and algal blooms (MDBC, 2007). It was known that the problem was associated with low river-flow regimes, and that increasing irrigation use was a factor that affected low river flows. By the 1990s, social awareness had increased toward sustainable water resource management in river basins globally (Sitarz, 1993). There was also a shift in policy preferences from direct regulation to market-based instruments (e.g. property rights and trade) to achieve environmental objectives (Jordan et al., 2005).

To curtail further water extraction, a cap on diversions was introduced in 1997. Increased water allocations to the environment were also proposed, even though it was apparent this would create a shortage in irrigation water and hence higher irrigator costs (Crase, 2008). By 2006 Basin environmental conditions had deteriorated rapidly, and media attention increased public awareness on over-allocation problems leading the federal government to act. Fueled by environmentalist claims and severe drought effects, a *National Plan for Water Security* was formulated with limited economic or scientific analysis. Essentially, perceived changes in social preferences communicated through mass media and the collective action of interest groups instigated policy change aimed at maximizing net social welfare. [3]Initial reaction from the beneficiaries of the status quo was to oppose government redistribution of rights to water resources, and the government's challenge was to communicate to the public that the change was in fact welfare increasing, taking all benefits and costs into account. This challenge was complicated by difficulties in identifying and implementing appropriate instruments to achieve policy change, such that the total implementation costs did not exceed the perceived benefits, and that the original policy intent remained intact. We will return to this issue in Section 4.

2.2. Economic grounds for policy change

What then was the economic logic behind this MDB policy change to effect water reallocation? Let us consider a graphical representation of this social choice problem (Fig. 2). Suppose social wellbeing from water use can be summarized by the net output from its use in irrigation and environmental services. Given available technologies (knowledge) that allow substitution between these services, the shaded area under the curve E_wI_w that bounds the attainable and efficient social opportunity set, represents potentially available benefits from different combinations of water

[1] We use the term choice sets to represent available options for firms and individuals to select when making decisions within the freedom offered by existing rules of society.

[2] Climate states hydrologically impact upon median flows, droughts and high flows.

[3] Net social welfare occurs via maximizing private rents subject to environmental and social standards. Notably, this policy change both strengthened consumptive (irrigation) property rights and increased their relative value due to a reduction in future supply uncertainty from continued over-allocation. This created private welfare gains. Consumptive water users would also be expected to benefit from further private welfare gains from enhanced environmental public good values and sustainability.