Moving towards a policy proactive irrigation sector: some Australian experiences

Tian Shi\textsuperscript{a} and Wayne Meyer\textsuperscript{b}

\textsuperscript{a}Corresponding author. Forestry Strategy, Primary Industries and Resources South Australia, GPO Box 1671, Adelaide, SA 5001, Australia. Fax: 61 8 8226 0476. E-mail: tian.shi@state.sa.gov.au

\textsuperscript{b}School of Earth and Environmental Sciences, University of Adelaide, SA 5005, Australia

Abstract

As a complex process, water resource management is characterised by the interactions among policy makers, stakeholders, implementers, and socio-political environments. In response, it requires designing suitable policies and managing their implementation. It also requires the irrigation sector to change its habitual behaviour to accommodate increasing environmental and community concerns and new government policies. Policy makers and irrigation practitioners are being called upon to learn from the past, and make trade-offs between the economic, social and environmental effects of water use. To build up the capacity of the Australian water industry in dealing with water management problems in the future, this paper analyses the interactions between water policy and irrigation practice in Australia, and outlines the synthesis of some findings from the reform experiences of selected countries. The insights drawn from this study will facilitate the irrigation sector to be more proactive to intended policy changes that aimed at achieving the sustainable development of industry, community and the environment.

\textit{Keywords:} Australia; Institutional arrangement; Irrigation sector; Policy proactive; Water management

1. Introduction: irrigation in a changing world\textsuperscript{1}

1.1. International background

Agriculture is the main user of water in most countries and nearly 40\% of the world’s food supply is grown using irrigation (\textit{Sherbinin, 1998}). According to the \textit{World Water Vision} (\textit{Cosgrove &...}

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Rijsberman, 2000), irrigated agriculture used 83% of the global consumptive use of water in 1995. However, with other uses (e.g., urban and environment) competing for water, the proportion of water available for irrigation is decreasing while, at the same time, the irrigation sector is increasingly challenged to meet the food demands of a growing world population (Meyer, 2005).

For much of the world there is a pending crisis of insufficient water, not because of an absolute shortage of water but because of mismanagement of water resources (Molden, 2007). Worldwide, awareness of the need for major reforms of water law, policy and management has increased in many countries, such as in Mexico (CNA, 1990), Australia (COAG, 1994), Spain (DGOH, 1996) and South Africa (DWAF, 1997). Numerous international programs, meetings, organizations and activities have been mobilised to promote sustainable water management, such as the Global Water Partnership\(^2\), UN-Water\(^3\), World Water Council, and the World Water Week in Stockholm.

While nations may differ in their aspirations, stages of development and level of water scarcity, the allocation and use of water resources are often critical to achieving regional and national goals addressing efficiency, equity and social welfare (Livingston, 2005). The World Bank (1993) has set a series of principles for the development and management of water resources. More recently, new policies and legal and institutional reforms aimed at more efficient and equitable distribution of water among competing users have been developed, such as the EU Water Framework Directive (Quevauviller et al., 2005) and the UN Millennium Development Goals on water and environmental sustainability (UN, 2005).

A common problem for national water management is the fragmentation of responsibility between different agencies. One of the challenges is to coordinate the flow of necessary information and reconcile different views among the large and diverse interest groups. In this sense, integrated water resources management and integrated water agency governance are necessary to deal with water management issues (Bauer, 2004). Coordination and cooperation between water users, water regulators and water governance is important if good practice in water management is to be realised. As reflected in the Dublin Principles, water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels (ICWE, 1992).

### 1.2. Australian domestic setting

Although Australia does not have the same level of concern about total water security demand as in some other parts of the world, the country still faces significant water resource issues such as competing allocations, recurrent drought, poor water quality and the need for increased environmental flow in some heavily used river systems. During the mid 1980s it became clear that existing water management arrangements in Australia were inadequate. In 1994, the Council of Australian Governments\(^4\) (COAG) commenced a national water reform process to make the necessary changes in the water industry (COAG, 1994).

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\(^2\) An international organization established in 1996 to promote and help implement the Dublin Principles around the world.

\(^3\) An inter-agency mechanism established to follow up on the water-related decisions of the World Summit on Sustainable Development and the Millennium Development Goals concerning water.

\(^4\) COAG comprises the Premiers of the various sovereign states, together with the Prime Minister of the Commonwealth of Australia and debates matters of national significance. It has become the key policy forum on natural resource issues, including management of water.
Effective water management requires collaboration from the community, water agencies, researchers and policy makers. State governments are required to develop and implement a comprehensive system for water management within an environmentally responsible framework. Legislation has established competitive markets for tradable water entitlements as the most appropriate instrument for allocating scarce water between competing users (Dunlop et al., 2002; Shi, 2006a). More recently, the concept of integrated water resources management has been articulated in the National Water Initiative (COAG, 2004). These changes correspond to an international trend for water management to shift from a centralized command and control approach towards devolved processes of markets and community responsibility (Saleth & Dinar, 2004).

In Australia, the interaction between irrigation practice and water policy is dynamic and complex. Irrigators frequently complain about the degree of uncertainty associated with policy reform processes. They express particular concern about centralized government policy reform processes that can run for long periods and explore propositions that threaten investments and local reforms that are already underway. It is often perceived that those involved in policy making give too little consideration to the impact of such reform processes on irrigation investment and practice at the local level (Young et al., 2006).

Appropriate decision-making processes and timely information sharing are essential. However, policy makers do not always have the information they need and research work on policy frameworks is fragmented, poorly communicated and often dissociated with the reality of decision-making (Goninon et al., 1997; Stakhiv, 1998). Despite a recent study (Young et al., 2006) to investigate the impacts of high level policy reform on irrigation practice and investment, so far there has been no explicit analysis of the nature of irrigation and policy interactions in Australia that explores both past experience and potential opportunities. As indicated, collaboration is important for successful water and natural resource management and improved institutional arrangements are essential for fostering collaboration (Margerum & Whitall, 2004).

This paper explores the nature of interactions between water policy and irrigation practice particularly from an institutional perspective to identify potential opportunities for the irrigation sector to become more anticipatory and active during policy development and implementation.

2. Irrigation, policy and institutional arrangements

2.1. Policy formulation and irrigation practice

The development of irrigation policies and regulation is a demanding process that requires technical feasibility, scientific knowledge, legal understanding and socio-economic consideration together with intensive stakeholder consultation. As an example, consider the issue of water re-allocation that

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5 A blueprint signed by the Commonwealth and most State and Territory governments for the next decade of reform of Australia’s water management. It attempts to achieve equitable access to and sustainable use of water resources by all stakeholders (including environment), while maintaining the characteristics and integrity of water resources within biophysical limits.

6 In Australia the water market policy settings have arisen through greater centralisation of the structures via COAG and National Competition Council (NCC) and funding allocations being tied to the implementation of these markets. The role of NCC and competition payments is a key and unique aspect of Australia’s water policy evolution.
potentially reduces the availability of water for irrigation and establishes environmental flow rules in the
supplying river to achieve environmental benefits. There are significant trade-offs in terms of reduced
production from irrigated agriculture and, in the case of rice and horticultural production, large
investments in high-value regional processing industries are at risk. Hence, changes in allocation policy
can have significant flow-on impacts for regional income and employment. In general, water policy
reforms are subjective, path dependent, hierarchical and embedded within the broad social, cultural,
economic and political context of a region (Saleth & Dinar, 2004).

Irrigation policies need to be cognizant of water access rights, water delivery policy, cost recovery, and
system management arrangements. To a large extent, government strategies for water development,
allocation and management determine the effectiveness of irrigation sector performance (Wade & Seckler,
1990). Water policy should be dynamic because what is considered best practice today will change in the
light of experience, technology and prices. Therefore, an adaptive management approach is needed to
ensure water policies reflect an evolving understanding of natural resources and technology, combined
with law, institutions, economics and communities (Carter & Howsam, 1998; Howsam et al., 1999).

Irrigation policy must be simple to understand and implement and acceptable to irrigators and water
delivery managers (Burt, 1996; Horst, 1996). Practical irrigation policies must also recognize that
hydraulic, weather, crop, and soil conditions are dynamic and prone to uncertainty (Burt, 1996). As a
result, ongoing discussions are necessary among stakeholders to coordinate the needs of research, policy
and practice groups. This requirement has highlighted the importance of improving and increasing the
information flow within and between these groups. In this context, improved interaction between
irrigation practice and water policy represents one of the key potential areas to improve the performance
and sustainability of the irrigation sector.

2.2. Policy choice and institutional arrangements

The large and diverse interests in water and irrigation policy and management results in a plurality of
institutions relevant to any particular water management issue (Bruns & Meinzen-Dick, 2005). These
institutional interests range from national and regional to local with, for example, local rules adopted by
the water supplier, the distributor and the user, and underpinned by complex regulatory and market
structures (e.g. state environmental laws and market-channel structures7) (Martin & Verbeek, 2000).
Local rules generally reflect the social and power arrangements within and between irrigation
communities and influence their water access rights and capability to adjust the distribution of water.
They are often interpreted and acted on with different emphasis in different locations. As a result, these
local rules are often inconsistent with national or state environmental legislation and other water acts. In
some cases state agencies do not have the capacity to monitor and enforce the state definition of water
access rights, while accepted community norms have greater influence (Bruns & Meinzen-Dick, 2005).
The resulting local, often unwritten rules restrict the flexibility of water supply to some individual users
and, hence, the potential of flexible and effective irrigation policy (Van Hofwegen, 1996).

Formulating and implementing flexible and effective irrigation policy has a number of potential
constraints in addition to the distractions that can result from local interpretations described above.

7 These more general arrangements such as environmental laws and standards also have strong impacts and should not be
ignored as part of the matrix.
Competing and sometimes conflicting policy positions of government, irrigation agencies, farmer groups and individual farmers are the first set of limitations. A second set of limitations comes in the translation of these positions into the procedures to manage the establishment and operation of irrigation infrastructures. Sometimes local implementation and interpretation of operating rules can be contrary to either the spirit or literal interpretation of formal legislation or administrative procedures (Ostrom, 1992). These rules-in-use form the third set of limitations. Policy choices are usually made at the beginning of irrigation development and changes in policies often require changes in infrastructure and organization. The compromise made between the requirements posed by new policies and the feasibility of modifying existing infrastructure forms the fourth set of limitations (Van Hofwegen, 1996).

The choice and development of institutional structures supporting water and irrigation policy is ultimately a compromise between the physical nature of the resource, human reactions to policies and competing social objectives (Stringer, 1997). The social transaction cost related to the development of a new set of rules for water delivery and distribution, for example, can be very large resulting in either no effective change or quite limited change. Non-economic considerations, conflicting interests and a lack of effective leadership can inhibit change (Steenbergen, 1996).

2.3. Policy implementation

Policy implementation is a complex socio-political process of balancing the requirements of political and social acceptability, economic and technical feasibility and administrative reality. Gunn (1978) identified ten conditions for successful policy implementation:

- the circumstances external to the implementing agency do not impose crippling constraints;
- adequate time and sufficient resources are available to the program;
- the required combination of resources is actually available;
- policy is based upon a valid theory of cause and effect;
- relationship between cause and effect is direct and there are few intervening links;
- there is a single implementing agency, or at least a dominant one;
- complete understanding of, and agreement on, the objectives to be achieved with these conditions persisting throughout the implementation process;
- tasks are fully specified in the correct sequence;
- perfect communication and co-ordination; and
- those in authority can demand and obtain perfect compliance.

In practice it is nearly impossible to meet all of these ten conditions. As Pigram & Mulligan (1991) point out, conflicts and resistance always emerge because of the complexity of the policy intent, the environmental conditions and how the policy is perceived by implementing organizations and target groups. There are other elements that should be considered in minimising resistance to policy implementation, such as identifying an influential policy champion, developing relationships and trust, using targeted public relations information, timing and monitoring. Policy change is not a one-time event but a continuous process that moves in response to both internal factors (e.g. water scarcity, performance deterioration and financial non-viability) and external factors (e.g. macro economic crisis, political
reform, natural calamities and technological progress). From a policy implementation perspective, the synergy from these factors can be exploited with a sequential reform strategy (Saleth & Dinar, 2005).

3. Emerging trends in international irrigated agriculture

While irrigation has made significant contributions to socio-economic development in many places it has also created problems, for example salinisation of land and water resources, adverse socio-economic and cultural effects and environmental damage (Van Schilfgaarde, 1994; World Water Council, 2000; Molden, 2007). In the last 50 years, population growth, urbanization, and changes in production and consumption patterns, have placed unprecedented demands on water resources worldwide (Saleth & Dinar, 2005). Humans have already used more than one half of all accessible surface water runoff. This proportion is expected to increase to 70% by 2025, thereby reducing the water available for aquatic ecosystems (Postel et al., 1996). In light of these trends, new approaches and policies are urgently needed to manage water resources rationally and equitably, which entail efforts to simultaneously address population dynamics, consumption patterns, and environmental management (Saleth & Dinar, 2000; Meyer, 2005).

Worster (1985) claims that in the last century, irrigation systems dominated by engineering technology typically had centralised (“top-down”) management, which is not always in the best interest of irrigation farmers and the local community. This large-scale irrigation development leads to a concentration of power and wealth through a hierarchical system of management and thus social structure. However, many of these problems can be minimised by improved technology, policy and management and by adequately addressing cultural, social, and environmental aspects (i.e. an integrated assessment of options). As a general rule, gradual development of existing local irrigation practices and farmer (“bottom-up”) management may ultimately be more successful (Van Schilfgaarde, 1994). Experience indicates that once an irrigated region is established, a “bottom-up” management style is more responsive to farmer demands and local conditions and this ultimately leads to more efficient production systems.

Despite country-specific variations, Saleth & Dinar (2000) have identified four common trends and patterns in institutional changes in the global water sector:

- from water development to water allocation;
- towards decentralization and privatisation;
- towards integrated water resource management; and
- towards economic viability and ecological sustainability.

These trends have been caused by two powerful factors: (1) the potential for economic benefits from allocation-oriented institutional change are substantial, particularly in water scarce situations; and (2) in a given political economy context, the cost of transacting institutional reform can be minimized and the usual inertia associated with the reform can be overcome through a gradual but sequential reform strategy. Taken together, these two factors have the additional effect of offsetting residual political resistance (Saleth & Dinar, 1999). For example, in the past, management of irrigation systems and

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8 That is, water sub-sectors and institutional components are prioritized in terms of relative performance impact, fiscal significance, facilitative roles for downstream reforms, and political acceptability.
delivery of water services to farmers was characterized by an excessive reliance on government. Now countries such as Mexico, Turkey and Colombia are achieving better-quality service by decentralizing the responsibility for delivering water to local governments, and transferring operations and maintenance functions to water user associations and farmers (Dinar, 1998). Meanwhile, problems caused by water scarcity demand changes in the criteria and objectives of water policies. Past experiences suggest that the effects of alternative policies for the irrigation sector are strongly dependent on regional, structural and institutional conditions (Varela-Ortega et al., 1998). In this regard, Sherbinin (1998) identified four broad criteria for designing water policies:

- take into account potential reciprocal impacts and responses;
- be sensitive to local contexts, draw on multidisciplinary knowledge and employ multi-sectoral strategies in problem analysis, policymaking, project design, implementation, monitoring, and evaluation;
- account for upstream and downstream effects and the shared nature of water resources; and
- use adaptive management to adjust to the changing relationships between water, population and landscape over time.

4. Irrigated agriculture and policy reform in Australia

4.1. An overview of irrigated agriculture

Australia’s structured irrigated agriculture began with the first irrigation scheme following the enactment of the Victorian Water Conservation Act of 1888 (Hallow & Thompson, 1998). Today, Australia’s irrigated agriculture occupies 2.5 million hectares of land with an annual gross value of production of 8,600,000,000 Australian dollars (ABS, 2004). Irrigated agriculture occurs on less than 1% of all agricultural land but generates nearly 50% of all profit from agriculture and contributes about 25% of the total value of agricultural exports (AWRA, 2000; NLWRA, 2002). However while the total agricultural sector has continued to grow in absolute terms, its relative size and importance has declined relative to the rest of the Australian economy. According to the Productivity Commission (2005) report, agriculture’s share of GDP fell from around 14% in the early 1960s to between 4 and 6% during the last two decades. The number of farms has been declining with a reduction of 46,000 farms over the 20 years to 2002–03, resulting in fewer larger farms (Productivity Commission, 2005).

Over the last 15 years, water use has increased dramatically, mainly associated with increased irrigation. Total water use increased by 65% between 1984 and 1997, surface water use increased by 58% (mainly in New South Wales (NSW), Queensland and Victoria), groundwater use increased by 88% (mainly in Western Australia (WA), NSW and Queensland), and water use for irrigation increased by 76% (AWRA, 2000). Community concern about the ecological condition of waterways has steadily increased and is now causing significant downward pressure on allowable levels of water withdrawal.

4.2. Major policy reforms, changes and key drives

Growing community awareness of water management problems such as salinity and river health helped stimulate the COAG adoption of the National Strategy for Ecologically Sustainable Development in 1992 which established general principles of sustainable natural resource development and
management on a national basis. Since 1994 there has been a series of high level water policy reforms in Australia designed to address issues of water availability, access, allocation and quality. Core activities covered have included cost recovery and pricing, institutional reform, allocation and trading of sustainable water entitlements, ensuring water quality and public consultation and education (Pigram, 2006). These policy reforms were associated with a variety of inter-governmental, Murray Darling Basin (MDB) wide and state level processes (Young et al., 2006). The main building blocks include:

- 1994—all Australian governments agreed on a national Water Reform Framework;^9^;
- 1995—a National Competition Council was established to audit reform progress;
- 1995—introduction of a “cap” to restrict the volume of surface water extracted from the MDB;^10^;
- 1998—introduction of a Pilot Interstate Water Trading Trial;
- 2001—adoption of a Salinity and Drainage Strategy;
- 2002—Living Murray process to address the declining health of the Murray-Darling River system; and

As a result, there have been significant changes affecting the irrigation sector in Australia (see Table 1 for a summary). All states in Australia have introduced new, or at least significantly amended, water legislation. In addition, in order to align the reform processes among states, the National Competition Council has used a tranche payment system, which makes a proportion of transfer payments from the Commonwealth to States conditional upon States’ meeting a number of water reform targets. Although the specific issues vary from state to state, there are common key drives shaping policy changes in irrigated agriculture, which include:

- the motivation to reduce the effects of droughts;
- emerging concerns to increase the share of water allocated to the environment;
- improving the efficiency of water delivery and irrigation practice;
- changing consumer demands for water;
- developing water markets and increasing the security of water access entitlements; and
- state budgetary pressures and dependence on commonwealth payments.

4.3. A case study of the Murrumbidgee irrigation area

In Australia, the implementation of the COAG water reform framework rests with state governments who have constitutional responsibility for managing water resources. However, the existence of a federal system significantly affects the capacity of states to deal with pressing issues in a timely and consistent manner. As a result, it makes water policymaking and implementation a long, drawn-out and often

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^9^ The framework embraces pricing reform based on consumption-based pricing and full-cost recovery, the reduction or elimination of cross-subsidies and making subsidies transparent, the clarification of property rights, the allocation of water to the environment, the adoption of water trading arrangements, institutional reform, expanded public consultation and participation.

^10^ Extractions refer to water that is diverted or taken from the river, which include water supplied to irrigators for agriculture, and supplied to satisfy stock and domestic, urban and industrial needs.
rancorous process, as different governments wrangle over jurisdictional issues or are involved in extensive intergovernmental negotiations (Howlett & Ramesh, 1995). Irrigation development therefore has been largely developed on a regional basis and with little expectation that there could be advantages in having a national, highly standardized approach.

The Murrumbidgee River system is the most regulated river in Australia. Between 40 and 50% of the water flowing down the Murrumbidgee is extracted for consumptive use, with about 95% of this used for irrigation. The Murrumbidgee Irrigation Area (MIA) is the biggest irrigation area located along the Murrumbidgee River in NSW (see Figure 1). The water reform process in the MIA has been characterized by a consideration of socioeconomic effects of government policy change and the establishment of community-based water management committees for policy implementation. For example, the issue of rebalancing consumptive and environmental uses of water is being approached mainly through the introduction of environmental flow rules, which were determined by community-based water management committees within an overall framework set by government. Table 2 illustrates the interactions between policy change and irrigation activity in the MIA. This case study highlights the necessity for institutional arrangements to be consistent with the facilitation of learning across the diffuse interests of policy makers, researchers and irrigation practitioners in policy-making processes.

5. Australian experiences and international comparison

With globalization and an increasing integration of world economic systems it makes increasing sense for countries to learn from one another and to identify policies and practices in sectors like...
irrigation that improve system performance (Saleth & Dinar, 1999). Some of the important experiences of the irrigation sector in Australia are identified below and then brief international comparisons are drawn.

5.1. Community participation and trust building

As Corish (2004, p. 9) points out, “[w]ith Australian farmers responsible for the management of over 62 per cent of the Australian landscape and over 80 per cent of our water resources, farmers are central players in natural resource management”. Therefore, involving communities is crucial to understanding local conditions, creating a sense of ownership, strengthening community capacity, and ensuring sustainable management of water and other natural resources. In addition, farmers’ participation in irrigation management is an important means for them to become aware of the problems, select their own solutions and rebuild the trust between community and government (Cheng, 1996; Young et al., 2006). This Australian experience has contributed to the international paradigm shift in water management in moving from centralised decision-making, administrative regulation and bureaucratic allocation towards decentralised allocation, economic instruments and stakeholder participation.
Table 2. Major changes in the Murrumbidgee Irrigation Area (MIA) of NSW (Source: derived from Young et al., 2006).

<table>
<thead>
<tr>
<th>Aspect</th>
<th>High level policy reform</th>
<th>Local or regional response</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water extraction</td>
<td>Murray Darling Basin (MDB) Cap introduced in 1995</td>
<td>As the Cap is expressed in terms of the long-term average diversion, allocations in MIA are based on availability, and rules governing use and trade reflect incentives for individual Cap compliance</td>
<td>Annual allocations have been managed to achieve the Cap requirements</td>
</tr>
<tr>
<td>Pricing reform and water supply</td>
<td>State bulk water pricing inquiry started in 1996</td>
<td>In 1997 responsibility for managing water distribution in MIA transferred from Department of Land and Water Conservation (DLWC) to Murrumbidgee Irrigation Corporation (a statutory state owned corporation)</td>
<td>Once management was transferred to MIL, irrigators’ concern about the water use charges diminished considerably</td>
</tr>
<tr>
<td></td>
<td>In 1996 state began the corporatisation of government owned irrigation areas/districts</td>
<td>The corporation was subsequently privatised through the establishment of Murrumbidgee Irrigation Limited (MIL) in February 1999</td>
<td>Since privatisation, water supply and delivery costs have been significantly reduced</td>
</tr>
<tr>
<td></td>
<td>State Water was set up on 1 July 2004 to provide rural bulk water services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water sharing</td>
<td>New Water Management Act introduced in 2000</td>
<td>Murrumbidgee River Management Committee was set up in 1997 to advise the Minister on environmental flow rules, which were announced in February 1998 and implemented in July 1999</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A draft water sharing plan was prepared by the Committee and placed on public exhibition by the Minister in mid-2002</td>
<td>The statutory plan was approved by the Minister in December 2002 Some amendments were made to the Plan in consultation with the Committee and it commenced on 1 July 2004</td>
<td>In MIA, high security water entitlement holders gave up 5% of allocation without compensation On average, general security entitlement holders contributed 5% of allocation to environment flows, but the year on year impact varies (up to 25% in very dry conditions)</td>
</tr>
<tr>
<td>Water trading</td>
<td>Water trading has been encouraged in 1994 COAG Water Reform Framework and 2004 National Water Initiative</td>
<td>MIL has a series of trade rules to maintain the Cap Temporary trade rules require lodgement of an intention to trade out, early close-off for intentions after allocation announcements, and the capacity to trade up to the quantity specified in the intention at any time (within limits imposed by state agencies) Permanent trade rules allow for unlimited trade of water savings, restrict trade to Cap share on a case by case basis, limit the trade in supplementary water to specified access areas, and avoid trades with high risk for the environment or other users</td>
<td>MIA has been a mature irrigation system and has gained considerable experience of water markets</td>
</tr>
</tbody>
</table>
5.2. A multidisciplinary and multi-stakeholder approach for policy-making

While policy making can occur in many ways, the Australian experience suggests a policy cycle is likely to begin with issue identification, then proceed through policy analysis, policy instruments, consultation, coordination, decision, implementation and evaluation (Bridgman & Davis, 2004). This is a dynamic process. Relevant stakeholders (i.e. policy makers, scientific researchers and irrigation practitioners) can have input to the cyclic process of policy design, development, implementation and review. In practice, the degree of influence is greatest for policy makers, little for scientific researchers and less for irrigation practitioners. Good practice policy development encourages consistency through consultation and stakeholder interaction. In this sense the irrigation sector can benefit from a multidisciplinary team approach involving hydrologists, engineers, economists, ecologists, social scientists and local stakeholders, who collaborate in all phases of a policy cycle. This practice can reduce the frequent differences between the needs and expectations of policy makers, scientific researchers and irrigation practitioners (Shi, 2004).

5.3. Collaborative water management

As Pigram & Mulligan (1991) point out, the perspectives of policy makers at the ‘top’ and the views held by those irrigators at the ‘bottom’ influenced by the policies are often quite different. This difference can be further exacerbated by those who claim to represent irrigator interests (i.e. industry groups and associations) and irrigators themselves. To improve the opportunity for successful policy implementation, ‘top-down’ planning processes of water authorities must be combined with ‘bottom-up’ involvement of the irrigators. For example, in the MIA in NSW collaborative management agreements between government water agencies and local communities have been established. Through this process, participants recognized that an attempt to maximize any single performance dimension of irrigated agriculture would seriously compromise another dimension, hence optimization was needed. International experience with collaborative water resource management in the form of sharing responsibility between communities and state authorities has been found to be a key mechanism to improve local involvement, ownership and responsibility for irrigation schemes (Simonovic & Bender, 1996; Marshall, 2002; Margerum & Whitall, 2004; Hooper, 2005; Sabatier et al., 2005).

5.4. Education and communication

In Australia, education and communication plays an important role in the reform processes through the irrigation sector. Communities and grassroots organizations need access to educational materials and training to improve their understanding of and ability to manage water resources. The Coleambally Irrigation Area in southern NSW, as part of their land and water management plan instituted a community education program that involved producing and presenting material about the origin, effects and good management of irrigation in their region (McCaffery, 1998). This process was seen to be important in gathering regional support for modifying and improving the irrigation system. This is consistent with Bandaragoda (1996) who suggested that the introduction of new irrigation policy or changes to existing irrigation practice must be accompanied by a change in the attitudes, awareness, social organization and the institutional framework of irrigation management. Campaigns through mass media can convey a sense of urgency regarding the need for improved water management. At the same
time, the technical capacity and institutional viability of existing water management institutions (e.g. environmental agencies, water boards, and government ministries) should also be strengthened. The adoption of sustainable irrigation practice is a social learning process which can be facilitated and enhanced through appropriate education programs, institutional frameworks and policy contexts.

5.5. International comparison

Among OECD countries, Australia has the third largest level of per capita water extraction, only after the USA and Canada (OECD, 2004). This high level of water commitment together with a rapidly increasing awareness of environmental degradation and the significant reduction in the prominence of agriculture as a major part of the total economy (Figure 2) have all contributed to bringing change in water and irrigation policy and management. According to the environmental Kuznets curve hypothesis, there is an inverted U-shape relation between per capita income and environmental degradation (Dinda, 2005). In this regard, Australia is among well developed countries such as the USA, New Zealand and Japan in which environmental concerns are playing an increasingly important role in agricultural activity.

Different countries are at different stages of institutional water and irrigation management reform. Australian water institutions, as well as those in Chile and in some US states such as California and Colorado are more mature than most other countries. A mature water economy is defined as one that is primarily concerned with reallocation premised on the better use of existing supplies rather than on the continual development of new supplies (Randall, 1981; National Research Council, 1992). The mature water economy emphasises demand management, rationalised water allocation, institutions and capacity building and market tools for promoting more efficient use and operations of existing water supplies (Molden, 2007). The Australian water sector has instigated some world leading practices in terms of water policy and institutional reforms. It not only delineates the respective sphere of influence for various government layers and water sector stakeholders but also promotes a desirable mix of administrative regulations and economic instruments (Saleth & Dinar, 1999). This has come about partly from the industry response to increased demands for improved water services and partly through

Fig. 2. Agricultural GDP share (%) and per capita income, 2000–01 (Source: Productivity Commission, 2005).
deliberate COAG water reforms effected since 1994. As a result, the water reform process in Australia has been relatively smooth and fast compared to that in other countries.

6. Discussion and policy implications

Improving policy, regulation, management and practice in the irrigation sector is a complex process with the mix of the legacy of previous development, multiple aspirations for future development, a complex of culture and tradition in the irrigation community and often limited training and education among irrigators and their advisors. Figure 3 illustrates the factors determining the evolution of irrigation practice. Even when new policy is introduced there is an inevitable time lag between implementation and actual changes, and without regular checking and adjustment, well intentioned policy can quickly lose alignment with the previous need (Saleth & Dinar, 2004). In addition, it is always important to pay attention to possible unintended interactions between various policies. One strategy that can help minimise unintended consequences (i.e. side effects that undermine the policy’s effect or create new problems) is to have a well developed science-policy interface that provides a long-term perspective for the irrigation sector and can rapidly assimilate technology and resource condition changes. This, together with a well practiced consultation process that enables community concern and social and economic implications to be aired and explored will assist improved policy positioning and implementation.

Meanwhile, it is important to realign political groups and create a pro-reform atmosphere that is conducive to substantive change. Water policy change is inherently difficult, and involves trade-offs between the benefits and costs of alternative institutional arrangements. These arrangements need continuous revision as demand pressures and technologies change, and as social experience with water-management arrangements progress. In the long run, organizations able to anticipate change and learn from experience are the most adaptive. When irrigation sector reform becomes part of larger political or economic reforms, its implementation will be easier. In this environment the irrigation sector can

Fig. 3. Factors determining the evolution of irrigation practice.
become a creative industry that is proactive to intended water policy changes. However, to be policy proactive, the relevant institutional arrangements need to be dynamic, willing and able to continuously respond to changing circumstances. Unfortunately the water sector and the irrigation sector in particular have often responded slowly and inadequately because of inappropriate or rigid institutional arrangements. Institutional development did not keep pace with rapid infrastructure development, undermining the efficiency of investment and failing to adapt to changing economic, environmental, and social conditions. Many of today’s water and irrigation water distribution bureaucracies were set up to construct major water infrastructure facilities. This heavy focus on infrastructure sometimes led to institutions and practices that were well suited for construction, but less well suited for the adaptive management needed (Molden, 2007). As a result, changes in infrastructure, regulation and management need to reflect the technical and scientific improvements as well as accommodate the changing political, economic and socio-cultural conditions of particular locations (Shi, 2003). To some extent, changes in the economic role of the irrigation sector and in the attitudes of local communities towards irrigation practice and investment have had a greater influence than more centrally imposed water policy. Unfortunately, institutional arrangements that have largely resulted from state policy have often impeded local improvement and adaptation.

Sustainable irrigated agricultural development requires clear understanding of the way people and their institutions interact with ecosystems. In this regard, a model that illustrates the interactions between water policy and irrigation practice is provided in Figure 4. Water resource management is increasingly seen as an issue with social and political as well as technical dimensions. It will be impossible to meet this challenge without substantial changes in water management policy and institutions.

By integrating the theoretical issues with the practical aspects of water policy reforms, this paper attempts to provide insights on the interface between the theory and practice of water institutional reforms. These reforms have been very important for the whole water sector to adjust and adapt to a maturing industry environment. They have also been critical for the irrigation sector because of its dominant position in relation to water use and its need to modernise the institutional arrangements that manage water allocation, distribution and application. The reform process has identified seven potential opportunities for the irrigation sector to become more proactive in anticipating and responding to policy changes in the future, which are summarised below.

![Figure 4. A model of irrigation policy making and implementation process.](https://iwaponline.com/wp/article-pdf/11/6/763/406743/763.pdf)
6.1. Shaping and influencing the development of industry water management policies, especially at the basin level

The fragmentation of institutions in the water sector is a serious obstacle to genuine integrated water resource management. With increasing competition for available water and environmental degradation of river systems and some irrigated areas there is an increasing need to manage water within a basin context. This is especially important for the irrigation sector which potentially has very large effects on river flows through large water withdrawals and drainage water returns to both surface water and groundwater. This means that irrigation developments will have significant effects downstream. It is important therefore that the sector acknowledges this and in interacting with water policy development it not only gathers and presents the most up-to-date scientific and technological knowledge but it does so while being cognizant of the connected basin-wide setting in which it operates. It needs to understand how the wider political process affects outcomes, and actively market the use of appropriate instruments for promoting more efficient, sustainable irrigation development policies.

6.2. Developing close partnerships with policy makers, scientific researchers and irrigators

The challenge of understanding technical or policy information can be a serious limitation to a stakeholder’s ability to contribute to a collaborative process. The involvement of policy makers, irrigators and researchers is essential because they collectively bring knowledge and experience necessary to formulate effective alternatives. A fundamental requirement of effective policy making is the integration of ecological, economic, social and cultural information at an early stage of the process. Maintaining close partnerships between stakeholders can empower participants by identifying areas of common understanding, encouraging them to explore solutions and reach a consensus (Simonovic & Bender, 1996). Collaboration is a process through which “parties who see different aspects of a problem can constructively explore their differences and search for solutions that go beyond their own limited vision of what is possible” (Gray, 1989, p. 5). Collaborative approaches can bring together information and analysis from a broad range of sources to develop a more holistic understanding of problems. New water policy development encompasses demand management, scientific research, education and persuasion to coordinate human behaviour. It thus calls for a new interface between science and policy that stresses the continuous updating of knowledge as well as improved communication of risk and uncertainty.

6.3. Establishing a roundtable to facilitate policy dialogue among all stakeholders

Making well-informed decisions requires the involvement of all stakeholders (e.g. policy makers, researchers, irrigators and environmentalists) in the decision making process. When problems become more complex, individuals will have a limited view of the problem. As Dörner (1980) points out, people have difficulty in identifying interconnections and thinking in causal nets, and generally tend to concentrate on parts rather than the whole. In addition, humans typically select information that confirms their beliefs rather than look for information that might refute their opinions. In this regard, group decision making processes can address some of the cognitive issues, relationship concerns, and technical communication aspects of working with diverse multidisciplinary groups (Simonovic & Bender, 1996;
Shi, 2004). To evaluate options in a multiple-stakeholder environment, some form of decision support is needed to effectively integrate the context of stakeholder perspectives and the results of analysing system behaviour. It acknowledges the validity and relevance of diverse knowledge and perspectives and seeks to avoid formulating problems according to one particular perspective to the exclusion of others. The integration of the insights, awareness, creativity and capacity of policy-makers, researchers and irrigators is the key to policy and management that enables sustainable irrigated agricultural development. Establishing a roundtable for dialogue is not about providing solutions but empowering stakeholders to explore solutions. In this team environment, it can enhance learning, expand the view of the problem, foster consensus and create commitment with a resulting decision (Vennix, 1996). Some of the potential promotional costs could also be saved by seeking an adequate level of consensus among stakeholders. As the policy process becomes a dialogue, it encompasses the multiplicity of legitimate perspectives and commitments, and provides new norms of practice.

6.4. Changing the perception of stakeholders and decision makers at different levels

Changes in perception play an important role in shaping policy and influencing decision making processes. The most important requirement to improve the design of an irrigation policy is to overcome conceptual barriers through interdisciplinary cooperation and cultivation of system thinking. New water policies will have little impact unless they change the way people perceive a situation. Reforms bring about mind changes that are affected by the information, consultation and engagement processes used. Sustainable development problems can be expanded to include two perspectives: the problem as an objective reality, and the problem as a mental construct (Landry et al., 1985). In the first case, because a problem exists objectively, all participants in the decision process see it in the same way (even if there are different solutions). The second case presents an alternative view which considers a problem to be a subjective presentation of an unsatisfactory reality. Common understanding (consensus) has to be established between the different participant perspectives before further progress can be made. It is important to note that problem formulation around issues of sustainable development is more of a social process than a technical one (Simonovic & Bender, 1996).

6.5. Developing good policy proposals with constructive advice and timely communication with policy makers

It is important that the irrigation sector is carefully integrated with the water policy and management process. Policy makers do not typically revisit policies once implemented even in the face of more recent scientific and technical findings, so that formulation of modified or new policy provides the opportunity for a self-aware and policy-relevant irrigation sector to bring new information and perspectives to policy making. Often, scientific research findings are not easily interpreted to give clear improvement that can be incorporated into policy making. The irrigation sector should take more responsibility for assembling and presenting relevant information in the policy making setting. Sustainable irrigation development requires clearly understanding the way people and their institutions interact with ecosystems. Therefore, not only must the biophysical basis of economic activity be understood, but also so must the sociological and political context. Appropriate arrangements and consultations need to be established to ensure that scientific results and local social and economic contexts are appropriately used in policy analysis and decision-making.
6.6. Developing strategies for enhancing the productivity of water at different scales

IWMI (2000) concluded that sustainable water management and food production on a world scale is possible through major improvements in management of water resource and irrigation technology. Increasing the productivity of water (i.e. more crops per drop) is central to producing food, to reducing competition for water and to ensuring that there is enough water for natural ecosystems. For agriculture to be sustainable, it must be biophysically possible, socio-politically acceptable, and economically feasible. It needs to balance the long-term costs of farm production against the short-term profits of goods sold at markets. The economic and technological environment greatly constrains the feasibility or viability of agricultural activities. This means no matter how technically feasible and potentially ecologically beneficial a new agricultural practice may be, it will not be adopted if it does not fit into an existing socio-political setting and promise tangible economic rewards (Shi, 2003). Sustainable irrigation sector development requires a consideration of the trade-offs between sustainability and other development objectives at different scales.

6.7. Incorporating environmental and indigenous concerns into water management policy and practice

As policies and practices based on perceived water surplus become increasingly counterproductive, water scarcity issues and environmental concerns become central issues. Political will must change decision-making to include all stakeholders, so that stakeholders have the power to manage their own resources. The increasing need for more sophisticated and scientific management will involve a greater focus on the regional level and delegation of policy-making power to local decision makers (Margerum & Whitall, 2004). Bringing indigenous people into the dialogue on water management priorities can yield new ideas that benefit all stakeholders. Participatory consultations can reveal inequities in water distribution and possible steps to improve performance which are especially useful during water-scarce periods. Key to this process is to make sure that diverse groups among the stakeholders are engaged in the assessment and policy development process.

7. Concluding remarks

The irrigation sector has been increasingly challenged to change its behaviour in managing water when faced with increasing environmental and community concerns and new government policies. As a result, policy makers and irrigation practitioners are being called upon to respond to the lessons learned from the policy dialogue and reform experience of the past, and make trade-offs between the diverse economic, social and environmental effects of water usage. This paper aims to provide a better knowledge and understanding of national and regional water management systems and environments in which water policies operate (e.g. the complex interactions between the evolving science and technology, policy and socio-economic factors), and draw some lessons to facilitate the transition of the irrigation sector from reactive policy taker to proactive participant in the policy making process.

The main purpose is not to offer prescriptive guidance on how the irrigation sector should be engaged in the policy making process, but rather to inform the industry and other interested parties of some insights on policy and irrigation practice interactions. In this process, what is critical is not finding
“right” institutional arrangements but identifying the conditions under which each arrangement can play an effective role, understanding what can be done to strengthen them and ensuring effective coordination and negotiation mechanisms are established among them. Endeavouring to understand these dimensions of irrigation development has been a dynamic social process, and understanding this complex process might provide an opportunity to bridge the gap between policy rhetoric and reality in practice, rather than maintaining the status quo. In order to achieve an improved decision-making process on irrigation sustainability, it highlights the imperative to explicitly study the institutional setting through which sustainable irrigation development policy and practice are evolving.

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