Agricultural Water Management xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Agricultural Water Management

journal homepage: www.elsevier.com/locate/agwat

Designing water abstraction regimes for an ever-changing and ever-varying future

Michael D. Young*

Faculty of Professions, The University of Adelaide, Adelaide 5005, Australia

ARTICLE INFO

Article history:
Received 17 July 2013
Accepted 2 December 2013
Available online xxx

Keywords:
Water trade
Water right
Water resource management
Irrigation
Environment
Climate change
Reform sequence

ABSTRACT

Most of the world's water entitlement and allocation regimes evolved during periods of abundance and, hence, are not well suited to the management of water scarcity. Development of the institutional arrangements necessary to manage changing demands and supplies is in its infancy.

Design criteria for the development of a set of institutional arrangements for the robust management of scarce water resources is offered and then used to develop a generic framework for the allocation and use of water. Variations to account for differences in ground, regulated and unregulated water resources are offered. The question of how best to sequence reform of existing water entitlement and allocation regimes is also addressed.

The result is a recommendation for the use of water sharing plans to determine how much water may be used at any point in time and an unbundled suite of arrangements that enable efficient but separated management of long term and short term considerations and, also, the control of externalities.

System-wide adjustment is facilitated through the periodic revision of water sharing plans. Individual adjustment to changing circumstances is facilitated through trade in entitlements and allocations.

Before the introduction of institutional arrangements that encourage adjustment through trade it is recommended that the abstraction regime used be converted into one that accounts for return flows and allocates water according to shareholder entitlement. Seniority, beneficial-use criteria and opportunities to third parties to prevent adjustment according to pre-specified rules should be repealed. Well-designed regimes can be extended to include dam-capacity shares and allow the use of market-based instruments in delivery of water-quality objectives. Pooling can be used to lower the costs of risk management.

1. Introduction

If there is anything that is certain about water, it is that demand for access to it and the maximum amount that can be taken sustainably at any point in time must be expected to change. The search for the most appropriate way to supply access to scarce water is now part of the global water agenda.

As the clock ticks on, an increasing number of nations are becoming aware of the pressures that ever-changing economic conditions, ever-changing technologies, population growth and ongoing climatic change are placing on their water management regimes. In many countries, social preferences for arrangements that return health to degraded wetlands, rivers and aquifers are on the increase (Young, 2013).

With a James Bond like wit, Catley-Carlson (2009) describes this suite of pressures and challenges as a cocktail to be stirred carefully.

> *"Take one world already being exhausted by 6 billion people. Find the ingredients to feed another 2 billion people. Add demand for more food, more animal feed and more fuel. Use only the same amount of water the planet has had since creation. And don't forget to restore the environment that sustains us. Stir very carefully."* (Catley-Carlson, 2009, p.2)

Drawing attention to the global importance of preparing to deal with these challenges, the OECD (2009) warns that, by 2030, over half the people living in the world will be reliant upon access to stressed water resources.

At any point in time and place, the bottom line is that administrators should expect that, even if the water use they are responsible for looks "very right" today, in a few decades' time the way this water is used will be very different.

Given the reality of changing supply and demand conditions, how should one think about the design of a regime that determines who is entitled to access water and, in times of scarcity, how access is to be rationed?

* Tel.: +61 408488538.
E-mail address: Mike.Young@adelaide.edu.au

0378-3774/$ – see front matter © 2013 Published by Elsevier B.V.
http://dx.doi.org/10.1016/j.agwat.2013.12.002

Box 1: Definitions
System: A connected set of water bodies which may include streams, lakes, rivers and aquifers.
Regulated water system: A system where the flow of water can be controlled by determining when and how much water is released from dams and/or allowed to flow over control weirs and other similar structures.
Unregulated water system: A stream or river where there is little or no opportunity to control the rate of flow. Unregulated streams and rivers typically have no dams, weirs or locks that enable the rate of flow from one reach to another to be manipulated.
Abstraction regime: The constellation of mechanisms (entitlements, allocations licenses, permits, etc.) used to determine who, when, how and how much water may be abstracted from a water resource pool.
Entitlement: A long-term interest in or entitlement to receive allocations or be allowed to abstract water from a water body.
Allocation: A defined once-off opportunity to take water from a water body. Usually defined as a volume. Sometimes defined as a maximum rate per hour when flow conditions allow abstraction.
Return flow: The water physically withdrawn from a system and returned back to the same or a different water body following use. Many towns abstract water for drinking, washing and flushing purposes and return the majority of this water to a water body following use. Similarly, many industries abstract water for cooling purposes and then return it back to a river after use. Irrigation is often associated with the return of a significant proportion of abstracted water back to a river or aquifer.
Over-allocated: A water body with entitlements which if fully exercised would result in a rate of abstraction that is greater than that which can be sustained.
Over-used: A water body where the quantity being abstracted is greater than that which can be sustained.

2. Proposition

The main proposition put forward in this paper is the observation that in order to manage this forthcoming cocktail of challenges, most countries will need to revise the ways that water entitlements, water allocations, use permits, etc. are defined. Almost all abstraction regimes that one can find around the world evolved during periods of relative water abundance and where rapid changes in technology were not common.

When viewed from this perspective, in many cases, it will be more efficient to replace the existing abstraction management regime with one that is designed specifically to enable the cost effective management of the many challenges that increasing water scarcity brings to a region. Meinzen-Dick (2013) reviews abstraction reform challenges for developing countries.

3. Water entitlement regimes

In this paper, the term "abstraction management regime" is used in preference to the more common "water-right" terminology (see Box 1). See Grafton and Horne (this issue) for more detail on water rights terminology, especially for Australia. The water-right literature is complex and built on legal traditions that discourage the development of new precedents. When one uses baggage free language, discussion focuses on the concept and tends to leave preconceived notions behind.

In most countries, abstraction management regimes used have their roots in century old traditions and in laws that are regarded as sacrosanct (Meinzen-Dick, 2013). In recent years, however, a few countries have chosen to totally respecify the way entitlements to access water are specified. Examples include Australia (Young, 2010), Chile (Bauer, 1998) and South Africa (Nieuwoudt and Backeberger, 2010).

From 1994 onwards, Australia has been replacing its traditional water licensing regimes with a new suite of water sharing regime (COAG, 2004) that have enabled entitlement and allocation markets to emerge (NWC, 2011).

In 1981, Chile introduced a new market-based framework for the allocation and management of water (Bauer, 2012).

Other countries, like China and the UK, are contemplating changing their entitlement regimes and, in particular, making them more conducive to the emergence of markets that enable people to take advantage of the opportunities that change create (DEFRA, 2011; Young, 2012a). Wu et al. (this issue) describe a new approach to basin-scale water resources management based on an evapotranspiration management approach.

The reasons for pursuing each of these reforms involve a mix of economic, environmental and social considerations. Australia began with an economic reform agenda that was quickly coupled with recognition of the need to resolve a suite of environmental problems. Chile, too, began with a focus on the role of water in economic development. South Africa recognized the need to include water entitlement reform in the arrangements needed to escape from a socially repressive apartheid regime. When one reviews the experience of these countries, it quickly becomes clear that no country got the sequence of reforms right. In each of the cases outlined above, countries have made serious mistakes from which other countries can learn (see, for example, Bauer, 2004, 2012; Young, 2010, 2012b; Bjornlund et al., 2012; Grafton et al., 2011).

The United Kingdom has recognized that it needs to include entitlement reform in the suite of arrangements needed for it to comply with the European Community water framework directives for it to improve the health of many of its water systems without adverse economic impacts (DEFRA, 2011). China has recognized that water markets and very different management arrangements will be needed if it is to avoid massive water scarcity problems that would be politically unacceptable and has introduced legislation that will enable trading to emerge as a means to manage water scarcity (Liu and Bin, 2003; Huaixi and Luo, 2009).

4. Concepts

From first principles, how should one think about designing an administrative regime that specifies entitlements, makes allocations and controls water use?

The **first design clue** comes from the *Tinbergen Principle*. Tinbergen (1952), who among other things was awarded the first Nobel Prize in Economics, was interested in policy arrangements that would produce outcomes that are dynamically efficient. That is, the constellation of instruments used would produce efficient and equitable outcomes through time and across space AND do this continuously without a need to revise them. Focusing on this idealized state, he observed that the number of instruments used to pursue policy targets matters.

If one wishes to use a market to deliver efficient outcomes through time, there should be as many instruments as there are targets (objectives).

Applied to water, this means that water access arrangements need to be separated into their component parts. Rather than a single abstraction licence, a bundle of licence, permitting and planning arrangements are needed. Each of these instruments can then be used to pursue different objectives and, where appropriate, operate at different scales. Drawing from the notion that a property right

Please cite this article in press as: Young, M.D., Designing water abstraction regimes for an ever-changing and ever-varying future. Agric. Water Manage. (2014), http://dx.doi.org/10.1016/j.agwat.2013.12.002