WORKING PAPER 28

Pricing instruments for sustainable water management

There is increasing interest in water pricing instruments as policy tools in a variety of contexts. This paper discusses use of these instruments towards achieving complex goals, often including social and environmental components. Case studies from Australia and South Africa highlight that the development of a policy regime to achieve multiple goals tends to be a multi-stage process.

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Introduction

Water pricing is a term that is used often, in a wide variety of contexts where the term has different meanings, associations and assumptions. From a policy perspective its definition has a critical importance, because it frames the discussion and can strongly affect stakeholder perceptions and in turn also affect policy choices. Our aim is to clarify what we mean when we talk about water pricing and its contribution to the sustainable provision of water to society.

We start by addressing the water pricing terminology. Thereafter, the potential uses of pricing instruments for water management are outlined, followed by an overview of how these instruments are currently applied and how they perform under various circumstances. The final section summarizes the key messages, which can be read as an invitation to further debate.

On the term “water pricing”

Without any further context, the term price simply refers to the payment required to receive a unit of a good or a service. In mainstream economic theory, prices are determined by the interaction of supply and demand in a perfectly competitive market for private goods, where prices rise or fall directly in response to changes in supply or demand (such as in the spot market for electricity). In the case of water, the reality is usually much more complex, necessitating a departure from the assumption of perfect competition. Water often has attributes that make it not strictly a private good. A private good can be defined as a good to which access can be restricted and whose use by one actor limits the availability for others. For water, common conditions of departure from private good characteristics include the potential for open access, ability for re-use and the existence of public environmental goods that are dependent on water. Another set of key differentiators to the perfectly competitive market for private goods are distributional issues from water use, both social and political (e.g. the human right to water), and environmental (both in terms of quantity and quality). How to manage the trade-offs between policy goals in these domains is one of the key challenges for water pricing.

Furthermore, water management tends to be highly scale-dependent. There is a significant difference between looking at raw water abstraction, which needs a macro-scale viewpoint to manage competing human and environmental demands for water from the same source, and municipal water supply, a micro-scale problem of water delivery, waste treatment and public welfare. Therefore solutions need to be negotiated at the corresponding level, and within a country or a basin a range of prices, in combination with other instruments, could be relevant.

A price that contributes to sustainable water management will need to reflect not only the costs of supply (i.e. service delivery), but also costs related to the scarcity of the resource itself (e.g. externalities and opportunity costs). This cannot be achieved through a single price, but through different prices depending on, for example, the source and type of use. Water pricing exists within social and political settings, where factors such as trust, power and status influence price formation, in addition to supply and demand. This means that even in competitive markets, a price is not necessarily a perfect or the only signal of scarcity. Actors’ preferences, which determine the perceived value of goods and services, and thereby the willingness to pay, are further determined by the socio-cultural context as well as the level of information that is available to them (Beckert, 2011). For these reasons, there is commonly a gap between the users’ willingness to pay for a good like water and the price necessary to achieve sustainable water management.

A useful distinction is to consider how the price is determined. To illustrate, we have divided pricing into two categories. The first category is administrative water pricing, where the price is set directly by a public authority, usually a service operator or regulator. Often these are tariffs or fees directly related to different functions of water management and services delivery. They can be based on supply-related costs, as well as opportunity and externality costs from the water use, or on all of them. The price-setting process is almost always regulated by a government agency, or by political decisions, with different degrees of independence from the service-providing entity.

The second category is market-based pricing where prices are determined indirectly via a decentralised pricing mechanism (such as a market). Here, the price is the outcome of an iteration process among various actors, meaning that the price is determined by supply and demand, but may also be influenced by historical, social and political factors, as indicated above. One example is a market for tradable water permits. A thin market, one with few buyers or sellers, will exhibit more complex behaviour, with outcomes that are the result of strategic interaction, such as direct negotiation or auctions. For market-based pricing, the role of regulation is primarily to determine the conditions under which water can be exchanged or used in production.

As mentioned above, from a theoretical perspective, a price is derived in a market setting. Therefore, when talking about administratively determined prices, some authors prefer using the terms tariff, charge or levy (see for instance Molle and Berkoff, 2007 and EUWI FWG, 2012). We follow however the common practice discourse on price instruments for water management, where “price” is used as an umbrella term for both fees, charges, tariffs and levies settled by public authorities as well as prices that arise through market forces.

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The roles of pricing for water management and water policy

Water pricing and water policy-making | Ideally the water management process takes as its starting point a set of water policy objectives that have been agreed upon at the basin or country level among the various stakeholders. Generally, these water policy objectives will fall in the following three categories of planning norms: equity, efficiency and environmental sustainability. Equity means that the way water is allocated and used is perceived as fair in society and that the human right to water is respected. The perception of fairness can, for example, include the equal right to the opportunity of a livelihood, as a basis for valuing and allocating water. It can also include an equitable sharing of costs from pollution or ecosystem degradation. Efficiency means that water and the resources invested in it are not wasted, but used productively, and in the most economically efficient way. Following the Brundtland definition, environmental sustainability in water management means that water resources are used in a way that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). This set of policy goals highlights the fact that water has values of multiple types and trade-offs between them may be necessary. The water pricing instrument has potential to contribute to multiple policy goals, but is not able to fully capture all types of values for water. It is therefore often necessary to find complementary policy instruments (OECD, 2009).

At the international level, prime examples of all three kinds of water policy goals are found in the 2030 Development Agenda, among the targets of Sustainable Development Goal 6, including target 6.1: "By 2030, achieve universal and equitable access to safe and affordable drinking water for all" (UNGA, 2015). Goals at other levels

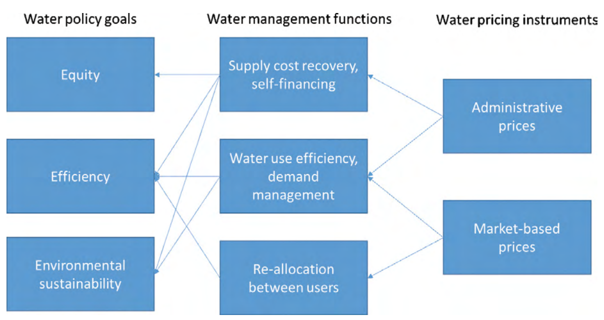

Figure 1: Linkages between water pricing instruments, water management functions and water policy goals.
Source: developed by authors.

of governance, including regional, basin-wide, national and local, are often influenced by the international level, while it is at these levels that water pricing instruments are implemented. As mentioned earlier, scale matters in water management, and therefore policy coherence across the multiple levels of governance is needed.

To achieve the chosen mix of policy objectives, a set of water management functions[1] needs to be carried out. For each water management function, one or more policy instruments can be applied. For the purpose of this paper, the discussion will be limited to those functions which can be performed through administrative or market-based water pricing instruments. These are supply cost recovery (or self-financing) of water services and water resources management, and increased water use efficiency and re-allocation of water between uses (see for example EUWI FWG, 2012). Figure 1 illustrates these linkages.

Cost recovery and sustainable financing | As mentioned, both the costs of supplying water services and the costs of managing water resources can be recovered through administrative prices, usually tariffs. Achieving equitable and universal access to basic water supply will not be possible without sustainable cost recovery[2]. Ensuring sufficient funds for water resources management is also an issue of equity, since the costs of pollution and other unsustainable management is often disproportionately born by poorer groups in society. At the same time, the level of tariffs needed to ensure self-financing may be unaffordable to low-income groups in society. This would violate the affordability criterion of the human right to water and warrants either well-designed and targeted cross-subsidies between households or a cost-recovery target of less than 100%, supplemented with funding either from taxes or transfers from other countries (such as ODA) (OECD, 2002 and 2009, discusses in more detail different ways of addressing this). Achieving this requires public authorities that are competent and committed to respecting the human right to water.

The policy goal of efficiency can benefit from supply cost recovery in the sense that if operation and maintenance costs are recovered, there is the financial possibility of

1 There are various ways of classifying water management functions. Molle et al. (2009) provide a useful overview.

2 Sustainable cost recovery implies a mix between affordable water tariffs and other sources of funding, including taxes and transfers from other countries (OECD, 2009).

ensuring measures such as leakage repair and proper planning of replacements that will avoid loss of water in the system. There may however also be trade-offs between supply cost recovery and water use efficiency targets, for instance if the variable part of a tariff is very large in proportion to the fixed part (OECD, 2009).

Cost recovery through tariffs can play several functions when it comes to ensuring environmental sustainability. Through pollution charges, environmental costs for pollution are paid by the ones causing them, and revenue is generated that can be used for example to finance water quality monitoring or for compensating other water users that are negatively impacted by the pollution. A water pricing scheme may include so-called payments for ecosystem services (PES), where environmental amenities are explicitly valued and users are compensated by downstream beneficiaries for contributing to their supply.

Administrative water pricing instruments are primarily used for this function, since market-based instruments only directly generate revenue for the public authorities in special cases. Most often, they only concern payments between water users in a market. One special case would be when a trading fee or tax is charged by authorities (an administrative price), in order to allow water market transactions[3], generally as an attempt to recover the operations costs of the market. Another special case, which is theoretically possible, but little practised, would be if public authorities held an auction for water use permits and used the revenue to finance water management.

Increase water use efficiency and manage demand for water | This function is closely related to allocation of water and prevention of over-use. It becomes more and more important in areas where water scarcity and competition for water resources is increasing. This is the intention of the often-cited conviction: "We do not value water sufficiently", or, expressed differently, that current water prices rarely reflect the scarcity value of water. The intuition behind this is that if water is expensive enough, the demand from individual users will decline and they would not need as large allocations as previously. Thus inefficient uses will be reduced and water resources will become available that can be allocated to alternative uses, or be left in-situ to provide for environmental needs. In the latter case, the scarcity price will also contribute to the environmental sustainability policy goal.

This is the primary contribution from water pricing to the efficiency policy goal. However, water policy will often consist not only of an efficiency goal, but also equity and environmental sustainability goals. In practice, many countries do make exemption from efficiency pricing for certain economic sectors that are considered crucial when it comes to job creation and national self-sufficiency in

3 This is legally possible in South Africa, where markets can be set up on a catchment or basin basis to determine the final price, but the WRMC can still be charged.

certain goods (energy, food and others). This may reflect the fact that equitable water use (for instance in terms of using water to ensure local livelihoods) is prioritized above economic efficiency measured squarely in monetary terms. However, it may also reflect that water policy is sometimes influenced by priorities that are counter-productive to sustainable water management. Alternatively, it may be an indication of the political and social difficulties of adjusting national development and economic activity to new levels of water scarcity.

Both administrative and market-based pricing instruments can be used for the purpose of managing demand for water. If a water tariff or the price in a market for water rights is high enough, users will demand less (or forego some of their intended use), or invest in more water-efficient technologies.

Re-allocating water between users | The allocation of rights to use water is an administrative procedure determined by laws and water policy objectives, in each jurisdiction. Once water rights are granted, they under certain conditions can return to the state (for example, in western United States where they can be forfeited) and can again be allocated following administrative or legal procedures. Or they can be re-allocated from one user to another. This is where market-based water pricing can enter, in the shape of a water market, as one re-allocation mechanism which is practiced for example in Chile, the western United States, and Australia, primarily among irrigation water users. In a comprehensive market with relatively low transaction costs, the price will tend to re-allocate water from users with lower water productivity to users to with higher water productivity. To manage trade-offs with social or environmental goals, water may be reserved, that is prevented from being in the market to begin with. This is the case in Australia with the Sustainable Diversion Limit, which is discussed later on in this paper.

Applications of administrative and market-based water pricing instruments

Application of administrative prices across the water management cycle | Administrative water pricing commonly refers to fees or tariffs that may be applied at a number of places along the water management cycle, starting with abstraction from different types of sources, followed by bulk and retail distribution, end use, and thereafter treatment, potential re-use, and finally discharge back to a water source. The institutional structure, including the water allocation regime, the services delivery models for households and agriculture, and the regulation of water quality, strongly determines what charges can or cannot be implemented. Examples of how this is done are further detailed below, including the use of tariffs for in-stream water use for hydropower generation.

A price can be sub-divided into charges along the water management cycle, each part directly associated with the specific costs of providing some facet of service. Examples of these types of charges include raw water abstraction fees for the costs of providing water from a specific source, groundwater charges stemming from pumping costs, pollution charges for the marginal cost of clean-up, or environmental charges reflecting the total cost of management and restoration. The charges based on supply costs may also be complemented by charges for the water itself, with the potential for source-specific charges to signal relative scarcity and match demand with available supply. Providing this level of transparency on water bills is useful for end users, highlighting that the price is rooted in the true cost of service provision rather than determined by fiat.

Raw water abstraction charges | The water allocation regime may feature a charge for abstraction of raw water which intends to cover the costs of supplying water from a certain source. This charge may also reflect the scarcity of the resource (that is, a price of the resource itself, based on its value in alternative uses, also known as the opportunity cost), as well as the environmental costs associated with raw water abstraction (OECD, 2015). In OECD countries abstraction charges apply to most uses but are most common for industrial water use (OECD, 2015), probably because they often access water through self-supply, rather than through a utility or other form of service delivery. Most commonly, volumetric charges are used. Charges are generally low, but variation is high between countries or regions and depends on use. For example in Germany, among the higher charges we find 0,31 EUR/m3 for groundwater abstraction (Berlin), while in Bremen the charge for surface water abstraction is 0,003 EUR/m3 for volumes larger than 500 million m3. In Estonia, for the purpose of selling mineral water, the abstraction charge is 2,11 EUR/m3, while abstraction of surface water for cooling costs 0,0016-0,0072 EUR/m3 (OECD, 2015).

Household water tariffs | Common administrative pricing structures include flat, volumetric, tiered and two-part tariffs. The challenge is to balance the complexity of implementation (e.g. rate setting and monitoring) with the ability to target demand that is wasteful or incompatible with goals. Single rate volumetric prices are directly related to the amount of water withdrawn or consumed in use. Tiered prices have fixed rates which change depending on the time or amount of use. One form of this is a dual rate, one for times of peak demand and one for times of low demand. This also commonly takes the form of increasing block rates (IBR), especially in developing countries (Whittington, 2002), where the marginal price increases for each user as their volume increases. Finally, there is a two-part tariff, which includes a fixed charge that generally is an attempt to achieve long-run cost recovery, combined with some form of marginal price, commonly either block rate or volumetric. In addition, before service delivery through piped supply is initiated, a charge for connecting the individual house to the network is common.

The above refers primarily to recent developments of the utility service delivery model, found in developed countries, as well as in urban areas of developing countries. In peri-urban and rural areas of developing countries, there is a larger variety of community-based service delivery models, as well as varying levels of service, from household connections to shared standpipes. However, in all countries, water supply has traditionally been funded through donor assistance or government budgets and to the extent that tariffs have been charged, they have had little relation with the costs of supply (Cardone and Fonseca, 2003; OECD, 2011).

Irrigation tariffs | There are some additional water pricing structures that primarily arise for agricultural uses. An example is per area prices, where charges are related to the area irrigated, often at either a flat rate or contingent on the specific crops grown. A related case is that of Niger, which levies irrigation charges based on the share of area cultivated, exempting farmers who face unforeseen hardships such as pests or water shortages (Abernethy et al., 2000). These are often seen as attractive options because of their relatively low monitoring costs, but this is likely to be at the expense of economic efficiency (Johansson et al., 2002)[4]. Another method is to combine water quotas with a price, either fixed or marginal, based on volume, which may also vary by crop (Molle and Berkoff, 2007).

Irrigation districts and water user associations are sometimes used to assist with the implementation of water pricing, pooling the resources of a number of individual farmers in order to jointly manage the water system and its associated costs. In some cases these organizations purchase water from the government or source provider, and then charge a tariff or operate a market-based pricing scheme to allocate among the association members[5].

Hydropower tariffs | Generally, water tariffs are applied to consumptive uses while in-stream or non-consumptive uses are exempt, but examples where tariffs also apply to hydropower operators are not unknown. One example is Brazil, where the hydropower sector is charged a financial compensation of 6.75% of the amount of energy produced. The revenue generated is allocated mainly between states and municipalities, who in theory could use it for water management improvements, but the funds are not earmarked for this purpose. One share is also dedicated to research on water management (OECD, 2015). Another example is found in Cameroon with the Sanaga River, where a water tariff for hydropower producers was introduced to finance the construction of the Lom Pangar regulating dam. In 2012, annual revenues of US$29 million were expected from the two hydropower plants installed at the time (Branche, 2015). In both cases administrative prices are used, for the purpose of generating revenue. In the first case, it is to cover costs of water resources management while in the second, the focus is on coverage of the costs of dam infrastructure.

Wastewater tariffs and pollution charges | Globally, only a small portion of all wastewater is treated and managed safely (Mateo-Sagasta, 2015). Pollution prevention policies and investments in wastewater infrastructure have not kept pace with population growth and industrial development (Hernández-Sancho et al., 2015). Major challenges relating to tariff setting involve however managing demand in such a way as to deter users from generating larger quantities of wastewater, while at the same time not inducing clandestine diverting of wastes to avoid charges.

In most OECD countries, for domestic water use, the same tariff structure is applied to both water supply and wastewater, commonly a two-part tariff. It is also common to have different tariffs for sewerage and its treatment (OECD, 2010). In most cases, volumetric

4 Table 5 in Johansson et al 2002 provides comparisons of pricing methods along the lines of potential economic efficiency, equity and implementation costs.

5 Chapter 2 in Tsur 2004 and Johansson 2000 provide more extensive overviews of agricultural pricing and related issues.

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wastewater tariffs have a close link to water supply tariffs and are calculated based on a percentage of water consumption (Stannard et al., 2009; OECD, 2010). Industries in OECD countries are increasingly being charged for wastewater treatment costs, based on the pollution load released, while a separate volumetric or two-part tariff for sewerage collection is typically calculated based on water use (OECD, 2010).

In addition to using wastewater tariffs for cost recovery, economic instruments can be used to incentivise pollution prevention. Most commonly, liability rules for release of pollutants and related effluent taxes are established according to the polluter pays principle. In Europe, this is being implemented in various ways, for instance through an effluent tax in Germany, calculated in terms of units of damage based on equivalents of ten pollutants (Möller-Gulland et al., 2015). In Hungary the water load tax has a similar design, but also accounts for the sensitivity of the disposal recipient (Rákosi et al., 2015).

Applications of market-based prices | Market-based pricing can take place either in the formal or the informal economy. A key example from the formal economy, although only practised in a handful of countries, is a tradeable water permits market. Allocated permits are openly traded amongst water users within a basin and the price is determined by supply and demand for permits. This need not always take place within a market structure, e.g. a situation with few participants can operate via auctions or negotiated trades. The structure of the trading will indirectly affect the price. For instance, rules that curb trades for the purposes of speculation would be expected to lower the price relative to a completely free market.

Examples from the informal economy are found in many cities, where the coverage of piped water supply does not reach all households. Here, markets appear in the form of re-selling of piped water by either stationary or ambulant water vendors. People relying on this mode of water supply typically pay several times the litre price compared to those who are connected to the network. However, it has been observed in Dar-es-Salaam, Tanzania, that in times of normal water availability, water vendors act as price takers and conform to the historically given price level. It is only in times of water scarcity that prices are determined by supply and demand market forces. It is interesting to note that under such circumstances, vendors often choose not to work in their usual selling areas, possibly to avoid a bad reputation (Kjellén, 2006). In some countries there are attempts by authorities to curb the price at water kiosks (including Malawi (Laisi, 2009) and Zambia (NWASCO, 2014), but water reselling is largely unregulated, both in terms of price and quality. Therefore, if the distance between the stand posts is long enough, local, unregulated monopoly markets may appear.

Performance of water pricing instruments in practice

Evaluations of policy reforms would give useful references for future policy designs, but are not very common, at least for the water domain (Dinar, 2000). Grafton et al. (2011) rightly point out that the performance of policy instruments should be measured against the policy goal they are intended to fulfil. For instance, in South Africa, the water policy framework clearly prioritizes equity above economic efficiency, and thus in this case the performance of water markets should be measured in terms of equity impacts rather than efficiency impacts. It is however far from always clear which is the primary policy objective, or the one targeted by a specific instrument (Peters and van Nispen, 1998). It becomes somewhat easier to assess the performance against intended water management functions, which is the intention of this section. The ambition is to provide a general picture and not a comprehensive review.

Performance of administrative prices in achieving supply cost recovery | Supply cost recovery is a common goal targeted with administrative pricing, where the price is set to recoup the short-run average costs of water delivery, i.e. operations and maintenance (O&M) costs. Long-term supply costs, i.e. capital costs of infrastructure, are often dealt with separately and are less frequently included in water prices. Cost recovery for irrigation often falls short of operations and maintenance costs, let alone capital costs, ranging from 20-30% O&M recovery in India and Pakistan to 75% in Madagascar (Schoengold and Zilberman, 2007). Looking at municipal utilities around the world separated by country income status, all groupings have median short-term operation cost recovery ratios near or above 1, with poorer performing utilities in lower income countries falling as low as 0.30 (van den Berg, 2015). In the European Union, where the EU water framework directive has been in force since 2000, including a principle of cost recovery, the European Environmental Agency (EEA) assessed in 2013 that cost recovery of O&M costs is generally high for household water supply, but that many water utilities rely on “hidden government subsidies for necessary capital investments”. When it comes to cost recovery for irrigation water, it ranges from 20-80% in the Mediterranean countries studied (EEA, 2013).

Performance of prices in achieving economic efficiency | Water tariffs are generally set and evaluated at regular intervals, although sometimes very infrequently, and rarely function as direct reflections of the water scarcity situation. However, even if tariffs do not reflect the level of scarcity at a given moment, from the perspective of economic efficiency, volumetric tariffs are still generally preferable to flat tariffs. There is evidence that both household and agricultural water users facing volumetric tariffs use less water compared to those paying flat ones (EEA, 2013). In the EEA study, household consumptive use was found to be less responsive to prices (inelastic), while municipal gardening and swimming pool use was more responsive (elastic).

Market-based prices should on the other hand be expected to vary more frequently in order to function as signals of scarcity. In the Murray-Darling basin, Australia, prices in the water allocation market have been observed to increase in times of drought and decline as water availability increased (Grafton and Horne, 2014).

Efficiency of water use can be focused on water quality instead of quantities. In addition to pollution charges, there are examples of markets focused on the trading of water quality permits. Such markets have so far had very limited activity in terms of market transactions (Morgan and Wolverton, 2008; Selman et al., 2009; Olmstead, 2010). The use of markets specifically for water quality is still an evolving field, and there are often not clearly understood links between specific interventions, household and community behaviours and policy targets such as health outcomes (Olmstead, 2010).

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Performance of markets in re-allocating water | True economic efficiency (i.e. optimal use in terms of social value) is also associated with allocative efficiency (i.e. an ideal distribution). In spite of this theoretical equivalence, there are a number of practicalities that make this ideal allocation unlikely in practice, including the presence of externalities, subsidies to specific uses or users, asymmetric information and large transaction costs relative to the price (Livingston, 1995). Among the existing examples of water markets, even the most developed ones, such as those in Australia, face performance issues related to re-allocation of water between different kinds of users (Easter and Huang, 2015). Trades affect downstream users, at a minimum since return flows are altered, and environmental water needs. Therefore markets need to be complemented with cost-effective mechanisms for conflict resolution with third parties, since the conflicts will otherwise hinder market transactions (Grafton et al, 2011; Easter and Huang, 2015).

Factors that influence the performance of water pricing

Water pricing reform is often part of a larger agenda and takes place under conditions that do not reflect the assumptions that underlie economic theories. Such assumptions include the rational behaviour of individuals, who operate with perfect information and face minimal transaction costs, and the assumption that groups can be treated as if they were a single actor. The state of institutions and the cultural and social context will influence the willingness to accept change. Political resistance to reforms, and the presence of special interests or rent-seeking behaviour, can affect not only the eventual choice of policy but the path of implementation. Such factors can explain why we often see water pricing implemented gradually, rather than as a single, large policy shift (Dinar, 2000). For illustration, this section discusses some further details of certain political economy and governance aspects.

Shared values in society | The multiple values of water can easily create tensions between groups in society who have differing sets of basic values. Between these groups water pricing easily becomes a topic of discussion, since a price creates a strong manifestation of the part of the value of water which can be easily measured monetarily, typically the value in use for economic production, which often does not address environmental or social values of water. Arguments often voice fears of water pricing being the equivalent of “commodification” or “privatization” of water (for example Barlow and Clarke, 2002; Bond, 2004), signalling distrust that the political leadership will ensure basic water services for households at affordable prices and sufficient and timely water for environmental needs. In many countries these are legitimate concerns and the primary focus should then be on basic governance reforms, to increase transparency, accountability and participation and the capacity to safeguard public water interests. To create shared values, opportunities for dialogue where the voices of all groups can be heard are crucial.

Institutional capacity | Grafton et al. (2011) present eight institutional dimensions that are used for assessing the performance of water markets: 1) recognition of multiple, public interests in water; 2) administrative authority and resources for water management; 3) coordination between public authorities at the same level of governance (for example ministries at the national level); 4) coordination between authorities at different levels of governance (for example between basin organization and municipalities); 5) clear definitions of water rights; 6) mechanisms for resolution of water use conflicts; 7) institutional adaptive capacity; and 8) accurate registration and titling of water rights.

A substantial level of institutional capacity, encompassing several of the criteria already mentioned, is also required for the use of water pricing for cost recovery (OECD, 2012a). Notably, correct calculations of costs are important. This includes, for example, horizontal coordination between authorities in urban planning and water services regarding service extensions. Further, appropriate systems and resources are needed for the administrative tasks of tariff design, billing and collection of revenues, as well as handling customer relations.

Willingness to charge | There may be many political reasons for keeping water prices at low levels that make it impossible for them to perform optimally (OECD, 2012b). In such cases, prices serve the interest of political elites rather than the public (see for instance Beckerdorf, 2012 for an example from Sudan). Researchers, civil society organizations, think tanks and others play an important role in awareness-raising on the negative effects of artificially low water prices (unless there are other policy instruments effectively fulfilling the functions of financing supply costs and water use efficiency), including infrastructure decay and wasteful use. They should also address the need to hold decision makers accountable for sustainable water management in the public interest.


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Addressing single or multiple policy goals | Another reason for poor performance of water pricing instruments could come from the fact that policy objectives are not well articulated. Although theory prescribes that there should be only one policy instrument per problem that we wish to solve (Tinbergen, 1952), and that complex goals should be addressed by a set of policy instruments, it is often the case that policy makers try to address several policy objectives with a single water price. In some cases, it is not even clear what policy objectives are being targeted (Peters and van Nispen, 1998). When additional types of goals are prioritised, e.g. encouraging economic growth, social equity or ecological integrity, often water pricing policies are mixed with additional policies. With an administrative price, an initial price rule is chosen, which is then adjusted via the use of taxes or subsidies in order to shift the price and achieve environmental or social objectives. It is also possible to target social or environmental goals by restricting specific uses or reserving quantities of water from sale or trade.

Two water pricing reforms: Australia and South Africa

We now present two country-level cases of water pricing, Australia and South Africa. Each has a complex system, established and developed to reflect their policy priorities, with a focus on market-based pricing and environmental goals in Australia and administrative pricing and social goals in South Africa. These examples show how policy instruments can be combined to achieve multiple policy objectives and how this tends to be a multi-stage process rather than a single, discrete change.

Australia and Murray-Darling Basin | The case of Australia is interesting for two primary reasons. First, Australia is a federal system, with constitutional control of water resting at the state level and management largely controlled by the public sector. In the 1990s all states agreed on water pricing reforms, for the purpose of using water more productively and increasing its contribution to economic growth, which was expected to be followed by social welfare improvements (COAG, 1994). The National Water Initiative (COAG, 2004) establishes common principles, including volumetric pricing when practical, and the separation of water rights from land. However the specifics of policies within states vary substantially, particularly with their treatment of water for agriculture[6]. Notable is that the 2004 agreement states that "governments have a responsibility to ensure that water is allocated and used to achieve socially and economically beneficial outcomes in a manner that is environmentally sustainable" (COAG, 2004, point 2).

The second characteristic of note is that pricing policy has been focused on water rights and entitlements. The two major trends in reforms in pricing policy at this level have been a shift towards market-based mechanisms for allocation and the incorporation of environmental flows, through both environmental charges and government-run water holders, managing water for environmental purposes. These water prices have historically been contingent on the quality of return flows, combining dimensions of water quality and water quantity into a single fee (i.e. price). A major problem that remains is that irrigators, who are often advantaged by subsidies, have their water use subsidised at the expense of urban users, who often face prices higher than the cost of service delivery (Crase et al., 2015). This, combined with the structure of environmental interventions, indicates that while environmental goals are stated to be important there is a limited willingness to trade off economic considerations in order to achieve such goals.

6 Crase et al. 2015 give details about these differences from state to state.

The Murray-Darling basin, spread across five separate states, presents one of the largest-scale cases of market-based pricing for water rights (entitlements) in the world. The current market has its roots in a non-tradable, statutory, licence-based rights systems that date at their earliest back to 1886. These were designed with the intention of having all water allocated by the state in order to meet policy objectives (Martin, 2005). These objectives initially focused on development of agriculture and employment, only in recent decades shifting to include environmental protection and restoration. Trade in these licences was slowly adopted, initially only taking place within the same catchment or irrigation district, but eventually expanding to allow for the possibility of inter-valley and inter-district trades.

Spurred by a drought, a series of water reforms in 2007 led to the establishment of the Murray-Darling Basin Authority in 2008. This expanded trading across state boundaries and introduced the sustainable diversion limit (SDL), which will come into force in 2019 based on a plan initially devised in 2012. The basic idea of the SDL is that diversions (i.e. abstractions) are capped at a level that allocates flows for the environment, with the remaining water allocated to users via tradeable permits. Participation in the market includes irrigation infrastructure operators, farmers, rural and urban water utilities, industry, and governmental environmental water rights holders (Grafton and Horne, 2014).

The SDLs include separate estimates for surface and groundwater, based on estimates of environmental requirements for local ecology and downstream ecosystems. These are divided into large-scale regions called shared zones, which are further sub-divided into catchment scale areas, referred to as resource units. Water recovery, i.e. new environmental flows, has targets at both the resource unit and shared zone levels, the latter of which may be met with water recovery from any of its component resource units (Commonwealth of Australia, 2014). This provides a clear example of the importance of scale, with the general goal of environmental sustainability sub-divided into nested goals that allow for appropriately targeted management.

The total initial SDL is set at 2,750 GL/year, although current plans target up to 3,200 GL/year of water recovery. The difference between the two is referred to as the SDL Adjustment Mechanism and is intended to allow for adjustments to the component SDLs. These adjustments must have no adverse effects on social or economic outcomes and must fit into two broad categories, "efficiency gains" (i.e. technology that gives the same social and economic benefits with less water) and "supply measures" (i.e. the achievement of environmental outcomes with less water). Shortfalls in the target for supply measures are to be filled with government buybacks of licences (MDB Ministerial Council, 2014). This is in addition to existing planned licence purchases by the government, which total 1,300 GL, up to the statutory cap of 1,500 GL[7].

This first stage will have taken over a decade to reach full implementation, from the creation of the Murray-Darling Basin Authority in 2008 to the first SDL in 2019. Although this is the most carefully developed large-scale environmental intervention to date, it remains to be seen how successful the component SDLs will be in terms of environmental outcomes. It is not clear that a flow-based approach will be sufficient to achieve desired environmental goals, and there is evidence that ecosystems cannot be managed simply by adjusting flows. Seasonality and infrequent events are found to have significant impacts on wetlands and their dependent species (Kingsford, 2000), and it is unclear if these can be effectively managed through the management resulting from the purchase of flow licences. Within the context of the proposed SDLs, it has been proposed that a programme of targeted wetland conservation should be added to improve conservation (Pittock and Finlayson, 2011). It is hardly an endpoint, with related issues such as integrating groundwater management and cross-subsidies across different uses remaining to be resolved.

The development of water pricing in Australia clearly reflects changes in policy goals, with a shift from a focus on development, which mixes economic efficiency and social goals, towards the inclusion of environmental goals on a statutory basis. The markets in the Murray-Darling Basin have accounted for over 80% of all entitlement and seasonal allocation trades in Australia, with prices changing as expected to reflect scarcity (Grafton and Horne, 2014). It should be noted that trades are not large relative to the total amount of water used, and that from a technical perspective nearly all water uses have a marginal value that exceeds the water price. In spite of that, gains from trade have been significant, with total economic benefits to society (i.e. GDP) ranging from 500 million AUD in a less dry year to 1.5 billion AUD in a recent dry year (National Water Commission, 2012). Two other important functions of this type of water pricing system are revenue generation for the government[8] and benefits from data availability due to increased monitoring (i.e. improvements in water management at a local level).

7 Current progress towards the SDLs is summarised in (MDBA, 2016a), with a detailed table available as well (MDBA 2016b).

8 The balance sheet of the Murray-Darling Basin Authority is summarised with projections in Tables 2.1.1 and 3.1 in Department of Agriculture, Commonwealth of Australia (2016).

South Africa | The foundation of water allocation and pricing in South Africa is the National Water Act of 1998, which replaced 92 separate statutes regarding water. The government is the custodian of water and is to manage it for the benefit of all persons in a sustainable and equitable manner[9]. Two policy goals are clearly prioritized in the South African system: equity and environmental sustainability. They are embodied through the concepts of the basic human needs reserve and the ecological reserve; the only uses that are backed by legal rights. Once these reserve volumes are established for a specific water resource, the right to use water for other purposes can be authorised through a licence that is limited in time, requires registration and that can be transferred permanently or temporarily[10]. Licensed rights will further only be given to uses that are in the public interest, and will be charged the full costs for water supply, including infrastructure development and river basin management (MacKay, 2000).

Water prices play several roles for the achievement of these policy goals, which are spelled out rather specifically in policy documents, including the National Water Act itself. Notably, subsidized prices are used to promote equity and economic development, and various water resource management charges to ensure cost recovery of activities needed to ensure environmentally sustainable water use. Generally, in spite of cross-subsidies and additional transfers, it has been a challenge to achieve sustainable financing of municipal water supply. This is due to incomplete knowledge on the status of infrastructure, and therefore on maintenance and other costs; the low collection rate of payments; and the fact that revenue collected is not earmarked for water costs, but often spent on other things (Schreiner, 2015).

At the household user level, equity is primarily promoted through the concept of Free Basic Water. It is rooted in the South African constitution, which states that "Everyone has the right to have access to (...) sufficient food and water" (Chapter 2, Section 27.1). Officially Free Basic Water was announced in 2001, with the intent to ensure that all users had free access to a minimum amount of water, 6 cubic metres per household per month. The costs of this would be recovered by higher income users paying for their higher use through an increasing block tariff (Muller, 2008). In addition, three types of transfers of public funds are designed to cover operations and maintenance costs as well as capital costs at the municipal and regional levels (Schreiner, 2015). In practice, Free Basic Water has led to improvements in access and availability, with over 90% of the population having access to water services as of 2011, although with varying quality of service (Farrar and Rivett, 2012).

9 See (Stein, 2005) for a discussion of the Public Trust Doctrine in South Africa with respect to water law.

10 Table 2 in (Perret, 2002) outlines all rights types in RSA and their associated conditions.

The policy has not been without challenges, however. There have been legal cases challenging the amount of free water, particularly its adequacy for large households (Muller, 2008). Affordability remains a concern, with the costs of expansions of service to poor and rural communities leading to higher prices, an issue which disproportionately affects black South Africans due to infrastructure investment choices made during apartheid (Schreiner, 2015). Further, it has been found that at the municipal level the Free Basic Water policy operates as a lump sum subsidy that does not significantly affect water consumption. It was estimated that aggregate consumer welfare could be increased by redesigning tariffs, so that no use has a zero price, spreading out the subsidy. This would increase welfare even for the poorest households and reduce the percentage of households consuming low quantities of water, a desirable policy goal according to the WHO (Szabó, 2015).

At the system level, South Africa aims to take a nationwide, holistic perspective on water pricing, through a water pricing strategy applied at the points of abstraction and discharge. The specifics of how raw water charges are determined stem directly from the National Water Act, with the first pricing strategy published in 1999 and revised in 2007. Another review began in 2012, and while a draft was available in 2015, as of early 2016 it has not been finalised (Department of Water and Sanitation, 2015). This revision is driven by the need to adjust previous policies to better reflect desired policy goals, particularly social equity and environmental goals. The final tariff will reflect a hybrid approach, with some charges levied uniformly on a national, regional, scheme or project basis, and specific types of charges also allowed. Table 1 highlights the major categories of use and the differences in charges they face (adapted from Table 7 in the Draft Pricing Strategy document).

Changes to the structure of charges are designed to better address both environmental and social equity goals. The new Waste Discharge Mitigation Charge accounts for the volume of water discharged from a point source of pollution and the degree of management activity necessary for a non-point source of pollution (Section 3.1.2). The Water Resources Management Charge is specifically levied for the protection, allocation, conservation, management and control of water resources. This includes functions such as disaster management, ecosystem restoration and control and enforcement of water use, explicitly funding the tools to manage the Ecological Reserve.

A criticism of the previous pricing strategy is that many subsidies, particularly in the form of caps on and exemptions from charges for agriculture, are relatively general with unclear targets and therefore benefactors of such policies (Schreiner, 2015). Such subsidies are not completely eliminated and are most obviously still present in the form of caps on certain charges for agriculture, but provisions are directly made for targeted subsidies to achieve specific ends. In particular, the redress of inequities stemming from apartheid, equitable economic growth and rural development are noted as such goals.

The final major change is the new Economic Regulation Charge, which will only be implemented once legislation is finalised to establish and define the activities of the Economic Regulator[11]. The regulator is expected to have the role of reviewing and advising the Minister of Water and Sanitation on all manner of statistics regarding water charges including revenue, cost and tariff data, affordability, collection ratios, sustainability and compliance (Department of Water and Sanitation, 2015).

In South Africa, reforms in water pricing have followed a clear trajectory over the past two decades, developing more effective targeting of their policy goals. Social goals are the top priority, included directly in the Constitution and the National Water Act, with environmental goals also prioritised in the latter document. Free Basic Water and the Ecological Reserve provide a foundation for pursuing these goals, with Free Basic Water in particular being a unique approach, contributing to increased access and affordability. The draft version of the most recent reform of the South African water pricing strategy builds upon these, containing concrete activities for improvements in both areas, targeted subsidies for social goals, and specific charges for management and pollution in order to more effectively manage environmental aspects of water resources.

11 The specifics of the scope of the proposed Economic Regulator are outlined in Appendix 5 of the Draft Strategy (Department of Water and Sanitation, 2015).

Table 1: Proposed raw water pricing components in South Africa

Category of use	Water resources management charge	Water resources infrastructure charge	Water discharge mitigation charge
Agriculture	Yes	Yes (capped)	Yes
Municipal	Yes	Yes	Yes
Industry and mining	Yes	Yes	Yes
High assurance (e.g. power plants ex-hydro)	Yes	Yes	Yes
Stream flow reduction (e.g. afforestation)	Yes	No	No
Hydropower	No	No	No

Note: All uses are charged the Water Research Commission Charge and the Economic Regulator Charge (planned for the future).

Summary of key messages

- The term price originally comes from economic theory, under assumptions of private goods traded in perfectly competitive markets. However, when applied to water, pricing instruments need to be introduced in a carefully regulated manner to account for the environmental and social values of water.
- Water prices can theoretically be used for several different water management purposes, including generating revenue, signalling scarcity and re-allocating existing water rights, which in turn will lead to a certain set of policy outcomes, sometimes implying trade-offs between policy objectives.
- To understand water pricing, it is important to differentiate between administrative and market-based prices; that is whether the price is set directly by a public, regulating authority or whether the price is set through multiple actions or influences, for example in a water market, where the public authority has the option to determine the conditions of exchange. Administrative prices are more useful for the purpose of cost recovery, while market-based prices have a larger potential for signalling scarcity and opportunity costs.
- Social issues and distributional concerns should be at the heart of the design of water pricing instruments. They can play a key role in fulfilling the human right to water (in essence, providing universal and affordable access to water for basic human needs). Otherwise, pricing may enhance possibilities to sustainably finance the extension and improvement of water services, but at the same time create affordability issues.
- The performance of water pricing instruments is generally imperfect in terms of recovering supply costs, ensuring economic efficiency and re-allocating water between uses. This is however not a strong argument for dismissing their use across the board, but an imperative for constructive and open dialogue on water policy goals, the role of water pricing in combination with other policy instruments, and the surrounding institutional framework.
- The introduction and use of water pricing instruments is inevitably and strongly influenced by the political and economic interests in society, as well as the prevailing water governance situation. Low levels of transparency, accountability and participation are likely to limit the effective contribution of water pricing instruments to sustainable water management.
- Designing and implementing water prices is a long-term exercise, which will take different shapes depending on the social, hydrological, environmental and economic characteristics of a country. This is well illustrated by the two cases of South Africa and Australia. In both cases, the water pricing reform has gone through several iterations of the theory – policy – practice cycle.

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