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Fiscal Instruments and Water Scarcity

GGKP Research Committee on Fiscal Instruments

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Executive summary

Three questions dominate most discussions about the relationship between fiscal policy and water security. The first question relates to the question of how to charge for the provision of water services and ensure that all people can afford access to these services. The second relates to the question of how to minimize the potentially adverse effects of water scarcity on economic progress. The third question focuses on the search for ways to curtail the perverse effects of some fiscal instruments used in other sectors on water security objectives.

Charging

One of the key fiscal challenges facing water managers is to find a way to signal the value of opportunities to use scarce water resources and promote the investments needed to ensure that it is put to its best use. This paper identifies an opportunity to achieve the social and economic objectives associated with the supply of water services by decoupling water pricing arrangements from the provision of the financial assistance necessary to ensure that all people can have affordable access to water. This can be achieved by charging users the full cost of service delivery and then using a separate fiscal instrument, such as an independently delivered rebate, to keep water affordable. The result is both more efficient and more equitable. The decoupling of water charging arrangements from the provision of financial assistance to disadvantaged households can be expected to speed investment in the arrangements necessary to provide affordable access.

Water scarcity

As populations grow and regions develop, water scarcity is becoming increasingly common. By 2050, much of the world will be living in areas where demand for access to water can be expected to place pressure on a water resource. Whether or not this stress hinders economic and social progress depends on the degree to which scarcity costs are revealed.

In essence, there are two ways to reveal scarcity: a scarcity price has to be added to water service charges, or sustainable diversion limits have to be set and market processes left to send signals about scarcity values. Scarcity pricing by governments is rare and politically difficult to implement during periods when it is most needed. When a sustainable diversion limit is not set, the default position during periods of extreme scarcity involves expensive regulation, supply failure and resource degradation, among others, which all come at the expense of economic progress.

The alternative approach is to improve the specification of water rights so that users are encouraged to make the best use of water resources. Global experience is showing that it is possible to put in place a robust abstraction regime and then leave users to find the best way to keep water use within sustainable limits. Robust abstraction regimes speed innovation and promote investment. Examples of success with this latter approach can be found in developed and developing countries.

Perverse effects

Fiscal instruments used in other sectors can have adverse effects on other water-consumption fiscal policies. When a sustainable diversion limit is set and enforced, the potentially perverse effects of fiscal instruments on water use can be controlled. When there is no sustainable diversion limit or the limit is not enforced, there is a tendency for some fiscal instruments to increase water security risks. For example, income concessions designed to encourage water use, input subsidies that encourage pumping and production subsidies all tend to increase water use. When fiscal instruments are used, the general recommendation is that they should be used primarily to speed adjustment. If needed as a long-term assistance measure, then preference should be given to fiscal instruments that are decoupled from factors that influence water use.

Contents

1. Background

This paper searches for ways to improve the role of fiscal instruments and approaches in the management of water scarcity and the pursuit of inclusive development objectives. The paper begins by defining fiscal instruments and water scarcity, and then turns to the politically important issue of how to make water services available to all at an affordable price. The paper then considers the role of fiscal policy in managing water scarcity and closes with a broader consideration of the effects of fiscal policies used in other sectors on water use.

1.1 Fiscal instruments

Fiscal instruments are used to influence:

- The *demand for goods and services*, including demand for access to water;
- *Private investment*, including investment in the water supply and associated technologies;
- *Private savings*, including water that is stored for later periods and money put aside to assist during periods of drought;
- The *distribution of income* (e.g. providing access to water at subsidized prices).

Much of the literature on green growth highlights the importance of finding ways to reveal marginal opportunity costs so that users are encouraged to search for efficient ways to use resources, manage risks and keep use within sustainable limits.

When it comes to water, discussions usually begin with a debate about the best way to charge for access to water and subsequently reveal the marginal opportunity costs associated with its use. Typically, discussions soon expand to include the consideration of the influence of subsidies, income taxation arrangements and the role of market-based instruments in influencing water use.

Box 1 contains a list of the fiscal instruments used to influence water use. Fiscal policy concepts associated with these instruments include two propositions: a) users should pay the full marginal cost of accessing resources, and b) separate instruments should be used to pursue independent objectives.

When separate instruments are used to achieve separate objectives – the Tinbergen Principle – prospects for the efficient and equitable use of resources through time increase (Young & McColl, 2005; Young, 2014a). Separation can be achieved by increasing the number of instruments used through processes variously described as “unbundling” and “decoupling.”

Box 1: Fiscal and economic instruments commonly used to influence water use

Charges

- Fixed charges designed to recover some or all of the costs associated with connecting to a water main, irrigation system and sewage system, among others
- Fixed charges associated with the ongoing provision of services, such as administrative overheads and the reading of meters
- Fixed charges associated with the cost of building and maintaining infrastructure, including dams, pipes, pumps and also the costs of protecting catchments, among others
- Variable charges associated with the volume of water used and/ or the area over which water is applied
- Variable charges associated with transactions, such as the sale of a water entitlement or allocation and relocation to another property

Taxes

- A levy on the value of land associated with a place where water is used
- A levy on the value of a water right

Subsidies, grants and donations

- Contributions from government to a water utility designed to reimburse it for the costs of providing environmental and other public goods
- Subsidies provided to make access to water affordable
- Arrangements enabling the accelerated deduction of the costs of installing water efficient appliances and infrastructure, among others, from income tax
- Exemptions to value adding and other taxation arrangements that apply to most other goods and services in an economy

Transfers

- Donations from other countries and organizations interested in improving access to clean water and sanitation services

Property right instruments

- Tradeable water entitlements that specify the nature of a long-term interest in water
- Tradeable allocations that specify a right to take a volume of water or irrigate an area of water for a specific period of time
- Tradeable pollution rights designed to maintain water quality

1.2 Water scarcity

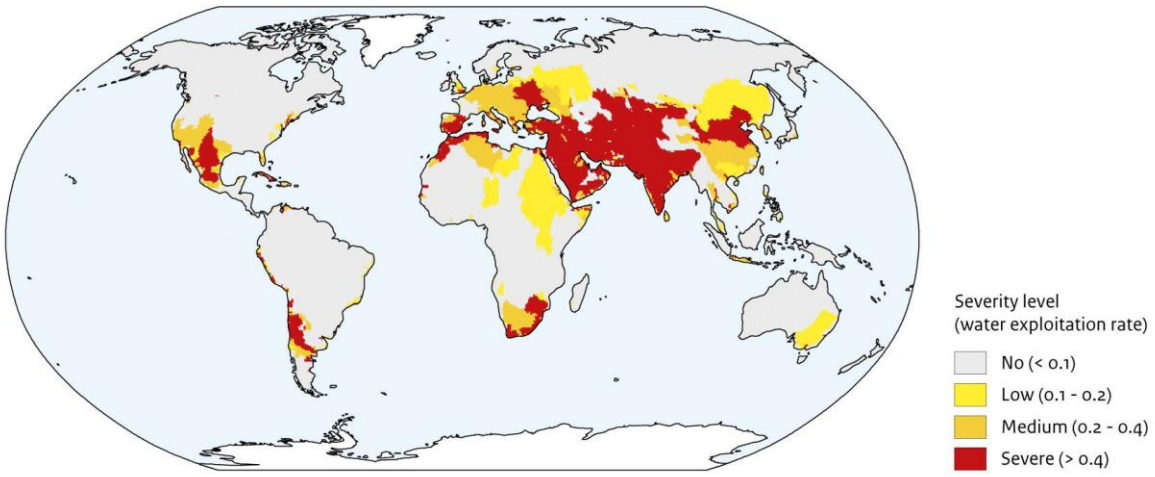
Classically, water scarcity occurs when water supply, its quality or the nature of the service offered is insufficient to meet demand. Scarcity can be short-term (e.g. a temporary drought) or enduring. Scarcity can be either absolute or present because of inadequate investment in storage and supply infrastructure, among others (see Figure 2). In many cases, it is necessary to add a quality dimension to the discussion and point to the polluted nature of many water supplies. Drinking water is scarce in some parts of Bangladesh, for example, as a considerable proportion of this country's groundwater is contaminated by arsenic.

Global data of the form necessary to model water scarcity is difficult to obtain and, hence, most international organizations have turned to proxy indicators. One of the most commonly used is the degree of stress being imposed on a water resource.

Stress is usually defined as the proportion of a water resource that is being used. The Organisation for Economic Co-operation and Development (OECD), for example, defines a region that is expropriating more than 40 per cent of its water as one that is severely stressed (see Figure 1). By 2050, the OECD predicts that more than 40% of the world's population will be living in a severely stressed water basin if no new policies are introduced. Over one billion more people will be living under severe water stress in 2050 than today.[1]

The causes of increasing water stress include increasing population, increases in per capita preferences for water intensive products, changes in the places where people live and adverse climate change. The International Food Policy Research Institute (IFPRI) has estimated that the flow-on effects of the mismanagement of water scarcity will place around 45 per cent of global GDP; at risk by 2050.[2]

Figure 1. Severity of water stress (2050)



Source: OECD (2012).

Water stress can be caused also by a failure to invest adequately in infrastructure. To this end, the International Water Management Institute draws a distinction between water bodies where scarcity is absolute (that is, the resource is fully developed) and water bodies where there has been underinvestment in storage and distribution systems. In these latter systems, supply tends to be much more variable and, hence, the risk of drought much greater.

The lack of provision of a reliable service can also result in water scarcity and disease. Two-thirds of China's rural population does not have access to piped water and, as a result, these people are much more prone to diarrheal disease and cancers of the digestive system. If the value of a statistical life is assumed to be $1 million[3], these health impacts have been estimated to cost the equivalent of

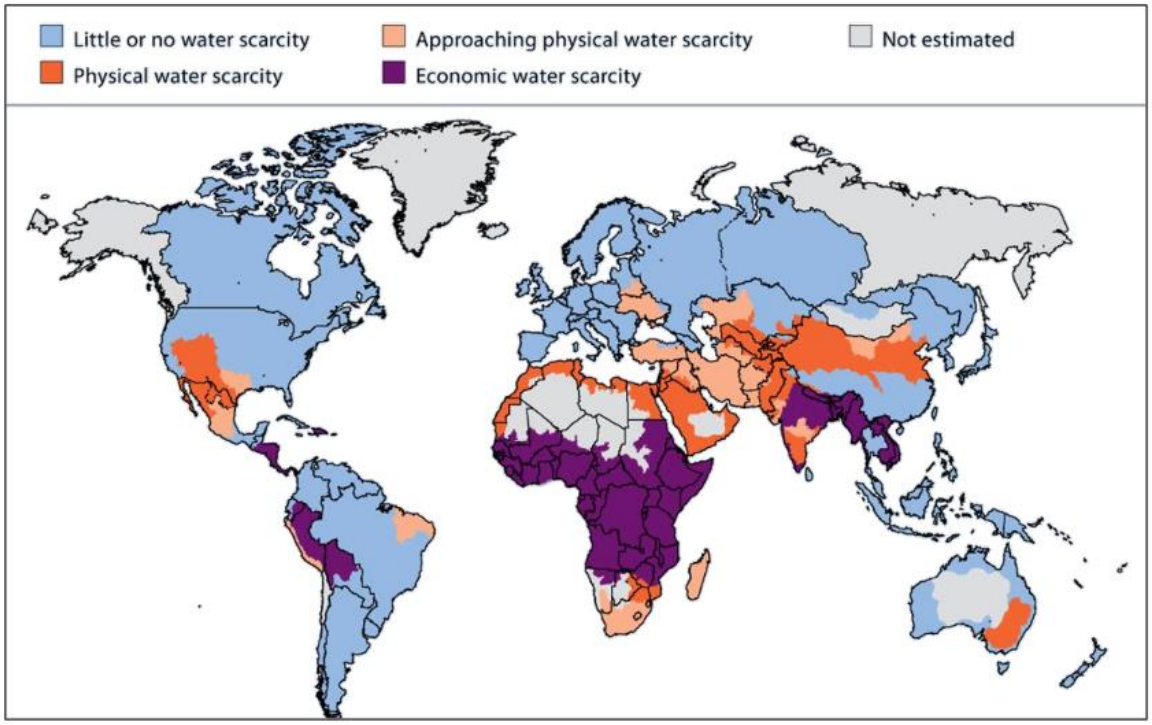
[1] Absolute numbers will increase from 2.8 to 3.9 billion people.

[2] Adapted from Global Blue's website, see http://growingblue.com/water-in-2050/. For a more detailed summary, see Veolia Water (2014).

[3] All dollar amounts are in United States dollars unless otherwise stipulated.

1.9 per cent of rural GDP. The amount needed to clean-up all forms of pollution, including water, has been estimated to be in the vicinity of 2 per cent of GDP (World Bank, 2007).

Figure 2. Areas of physical and economic water scarcity



Source: UNEP/GRID, UNEP/GRID Arendal Maps and Graphics Library (2008).

2. Charging for drinking water and sanitation

Having set the scene, the paper now turns to the vexed fiscal question of how best to charge households and businesses for access to drinking water and sanitation services. The World Health Organization and UN Water (2014) estimates that 748 million people lack access to improved drinking water and that 1.8 billion people use a source of drinking water that is faecally contaminated. Waterborne diseases still killed around 600,000 children in 2010, down from 1.5 million deaths in 1990 (WHO & UNICEF, 2014; WHO 2014).

In recognition of the social and economic implications of the lack of access to safe drinking water and adequate sanitation, the United Nations Commission on Human Rights has declared that access to an affordable source of clean water is a human right.[4] Concerned about the lack of progress, in 2008 the Commission appointed a Special Rapporteur on the human right to safe drinking water and sanitation.[5] One of the questions this paper seeks to answer is how best to ensure that access to water and sanitation services can be afforded by the most disadvantaged in society. This requires

[4] See http://www.ohchr.org/Documents/Issues/Water/Handbook/Book 1_intro_.pdf; UN General Assembly (UNGA), Resolution: The human right to water and sanitation, 2010 (A/RES/64/292); Human Rights Council (HRC), Resolution: Human rights and access to safe drinking water and sanitation, 2010 (A/HRC/RES/15/9); and HRC, Resolution: The human right to safe drinking water and sanitation, 2011 (A/HRC/RES/16/2).

[5] See www.ohchr.org/EN/Issues/WaterAndSanitation/SRWater/Pages/SRWaterIndex.aspx.

two things: a) the existence of the funds necessary to build and maintain the infrastructure necessary to make these services available and b) a means to assist those unable to afford to pay for access.

Households without access to clean water and sanitation do not go without water. Instead, they are forced either to collect their own water or purchase it from a water cart or equivalent secondary source. Often the water, so obtained, is of poor quality and, as a direct result, is one of the prime sources of the waterborne diseases that undermine opportunities for people to escape from poverty.

Water sourced from water carts and other similar sources is very expensive. In Jakarta, for example, the cost can be 50 to 70 times the cost of mains water provision (Fournier et al.,2013). In Nairobi, the cost of carted water is reported to be 20 to 25 times the price paid by those with access to mains water.

Without exception, every person without access to a safe, secure water supply would be financially and physically better off if they were offered access to a reliable mains water supply and adequate sanitation at the full marginal cost of doing so. The water they consume would be much cheaper and, frequently, much cleaner. Nevertheless, around the world, it is very common for governments to subsidize water use by using what is variously known as an “inclining” or an “increasing” block tariff regime.

Global Water Intelligence estimates that around 70 per cent of water utilities use an inclining block tariff regime that increases the amount paid per litre as household consumption increases. As there are many variants of this regime, Box 2 provides an illustration of the way inclining block tariff arrangements assist households and effect budgets. So that readers can focus on the concepts presented in the Box, the identity of the region is not revealed. Notably, the region described in Box 2 is on track to meet its Millennium Development Goals (MDGs) for water and sanitation. There is, however, a considerable difference between meeting these goals and providing access to a reliable service. A recent report reviewing progress in the region observes that, in one district, standpipe water access is limited to two hours per day and households with a connection can rely on access for only one hour per day.

Questioning the equity of inclining block tariff arrangements, Whittington et al. (2015) developed a methodology enabling the assessment of the distribution of benefits embedded in inclining block tariff regimes. Their results, summarized in Figure 3, make it clear that the majority of the benefits of subsiding via the use of an inclining block tariff regime go to wealthier households. In one of the case studies shown in Figure 3, the poorest 20 per cent of households receive 5 per cent of the subsidy benefit while the wealthiest 20 per cent of households receive 40 per cent of the benefits of the subsidy. In each of the case studies shown, the distribution of benefits is the reverse of what one would expect, that is, the wealthiest households always receive a greater proportion of the subsidy benefit than the poorest households.

Box 2: Typical water charging arrangements

The identity of the water utility whose data are used in this Box has been concealed so that readers can focus on the effect of inclining block tariff regimes on household income and utility budgets.

In the region, water is supplied to households and businesses by a publicly owned company. The government is the only holder of shares in the company and, hence, elects all board members.

Twenty-five per cent of the population does not have access to a piped water supply and 5 per cent do not have access either to a safe stand-pipe or a piped water supply. The total population of the region is just over 18 million people.

Households pay for access via an initial connection charge, a monthly service fee and an inclining block tariff in proportion to the water they use. As set out below, and following a recent review, ten monthly inclining blocks are used.

Monthly Consumption (m^3)	Volumetric charge per m^3 (US$)	Monthly service fee (US$)	Cost per m^3 (US$)
0 – 5	0.04	0.38	0.11
6 – 10	0.08	0.38	0.13
11 – 15	0.11	0.38	0.20
16 -20	0.30	0.60	0.45
21 – 25	0.44	0.75	0.80
26 – 30	0.66	1.50	1.32
31 – 40	0.79	3.00	1.78
41 – 50	0.90	4.88	2.32
51 – 75	0.98	7.50	2.52
Over 75	1.05	12.00	

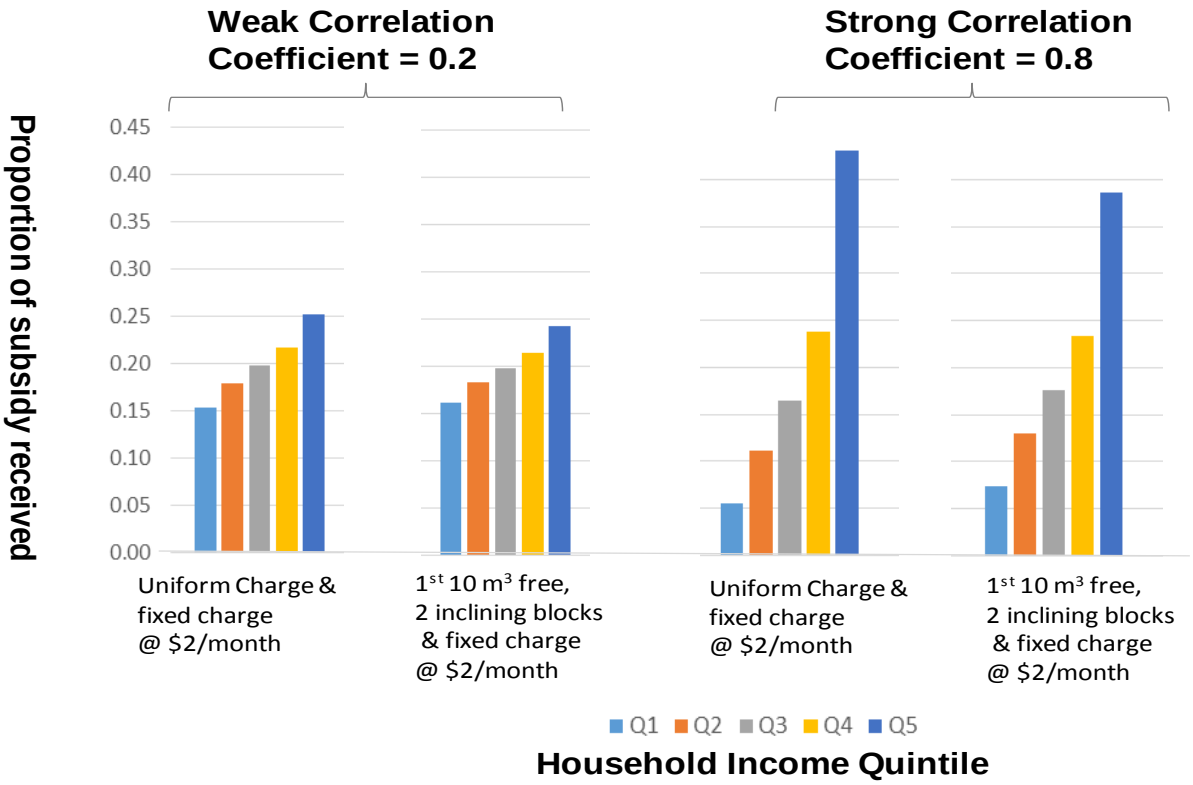
In 2010, the average short-run marginal cost of supplying water was \$0.15/m^3 and the average long-run marginal cost, which includes the cost of capital and maintenance, was \$0.35/m^3. As can be seen from the above Table, households that consume more than 20 m^3 per month are the only ones that pay more than the full cost of the service provided: \$0.35/m^3.

Total revenue collected represents 32 per cent of the total annual cost of operating the company. The financial gap of around \$171 million per annum is provided by government as a subsidy to the corporation. In total, this represents an average transfer of \$12 per capita. Moreover, water use is poorly correlated with household income.

Many poor households pay much more than long-run marginal cost and many wealthy households pay much less than long-run marginal cost. As a means to provide financial assistance to low income families, the inclining block tariff regime used appears to be very inefficient.

Source: Dharmarantna & Parasnis (2010) and water utility documents.

Figure 3. Distribution of inclining block subsidy regimes as a function of household income



Source: Whittington et al.(2015).

Challenging governments to think carefully about the efficiency of inclining block tariffs, Whittington et al.(2014) have shown that, if the aim of inclining block tariffs is to assist the poor then, in many cases, it would be more equitable and efficient to make an equal payment to each household irrespective of the income they receive!

From studies like these, it can be seen that as a mechanism to provide assistance to poor households inclining block tariff regimes are very inefficient. Aware of this problem, Chile has chosen to decouple water pricing arrangements from the provision of assistance to the poor and seek a much more targeted approach to the provision of financial assistance to disadvantaged households (see Box 3). In this country, water utilities are required to charge each household the full long-run marginal cost of service provision. Each household is then free to apply for assistance and have part of their water bill paid for them. The result is the much more efficient targeting of the financial assistance mechanism. No subsidy is provided to middle and upper income households.[6]

[6] Surprisingly, a significant proportion of low income households in Chile do not apply for assistance.

Box 3: Water charging in Chile

In Chile, most water supply and sanitation systems are operated through a company and financed almost entirely through revenues collected from users. Rather than subsidizing access to water, the Chilean Government operates a means-tested financial assistance scheme to households who without financial assistance would spend more than 5 per cent of their income on water.

Any household that expects to spend more than 5 per cent of household income on water is able to apply for assistance and, if their application is successful, the Government will pay part of their water bill.

The Chilean water pricing regulator is then left to set tariffs in a manner that sends clear economic signals about the cost of water supply and treatment and, also, the cost of securing access to it. Reviews are finding that the resultant targeting of financial assistance is much more efficient and the outcome is much more equitable than that being achieved in comparable countries, such as Peru, where inclining block tariff regimes are used.

Freed from the need to subsidize water use, Chilean water utilities are able to finance maintenance, among others, from the revenue they receive.

Sources: Bitran & Arellano (2005); Hearne & Donoso (2005); Williams & Carriger (2006).

In addition to the much more efficient targeting of financial assistance, decoupling enables water utilities to plan confidently and ensures that most households receive clear signals about the opportunity costs of water use.

Subsidies come at a cost. When a government subsidizes water use, it cannot subsidize other things. As a result, it is tempting for governments to reduce the size of the subsidy offered to a water utility. Whenever this happens, utilities respond by cutting back on investment in the replacement and extension of infrastructure. In the early stages of a reduction in government support for the costs of water provision, impacts are minimal, and as in most systems there is opportunity to delay things like the replacement of old infrastructure. Leaks, for example, can be tolerated. Gradually, however, the rot sets, service quality declines and the cost of restoring system function becomes extremely expensive and time consuming. Consumers, as a general rule, are willing to pay for a quality service, but tend to be extremely reluctant to pay more for a service that has yet to improve. Recovery is possible and has been achieved in various cities, such as Phnom Penh (see Box 4).

When considered from the above fiscal perspectives, the politically challenging conclusion is that poor and disadvantaged people would be better off if all water utilities are required to charge for the full long-run marginal cost of supplying reliable, safe access to water and sanitation services, and provision of the financial assistance necessary to make access to water affordable is provided via a separate mechanism.

Quarantined from budgetary processes that erode service quality and prevent investment, many of the world's poor would be much better off if a way could be found to transition towards the adoption of decoupled assistance arrangements so that as a last resort access to safe reliable services is always available to them at the long-run full cost.

Box 4: Transforming water supply arrangements in Phnom Penh

One well known example is the reform of water supply arrangements in Phnom Penh, Cambodia.

In a relatively short time and under astute leadership, water supply arrangements in this city were transformed. In 1992, only 20 per cent of residents had access and over 70 per cent of water use was not paid for.

Fourteen years later, over 90 per cent of residents had reliable access to a mains water supply and non-revenue water fell to less than 6 per cent. This transformational water policy experience has many characteristics. For the purposes of this paper, two stand out.

First, international loans arrangements were used to fund transition to a regime characterized by fiscal discipline. Users are reluctant to pay upfront for the delivery of a service that is yet to improve.

Second, the utility's leaders worked closely with poor people and persuaded them to argue for arrangements that got them connected over and above arrangements that favoured those already connected. As part of this process, a "finger print" petition from the disconnected poor requesting that they be connected at a reasonable price was submitted to the Prime Minister.

Today, the Phnom Penh Water Supply Authority is fiscally responsible, provides outstanding service and makes a small profit.

In 2010, the Authority was awarded the Stockholm Water Industry Award.

Source: Das et al. (2010).

The goal of providing water for all is financially feasible. If full cost pricing arrangements are put in place, the water utilities could afford to borrow the money needed to upgrade and extend the provision of services in the knowledge that the entire costs of this work could be funded from revenue. Governments would then be free to decide how much financial support to supply to needy households in a much more efficient manner.

Having identified a significant opportunity to free up the resources needed to improve outcomes in many countries, we can now turn to the important issue of the relationship between water policy arrangements and prospects for inclusive economic development.

3. Water security and economic development

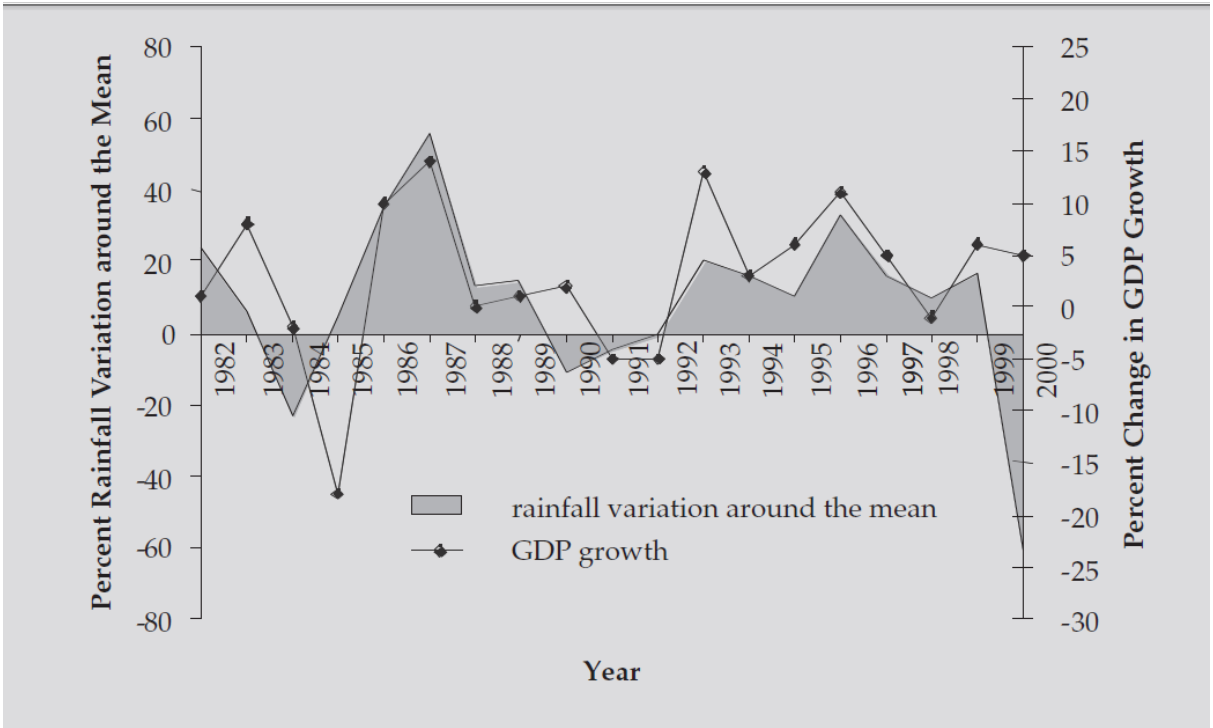
There is mounting global evidence that failure to invest adequately in water infrastructure is having a disproportionately high impact on opportunities for economic development.

In most developed countries, investment in dams is used to manage seasonal variability and reduce the impacts of climatic variation on prospects for economic growth. That is, investment in water storage arrangements typically has been sufficient to smooth out much supply variability by saving water for use in drier years. In Africa and some parts of Asia, however, this investment still appears to be inadequate (Figure 2).

In Ethiopia, for example, there has been little investment in water storage needed to smooth out the adverse effects of climatic variation. As a result, droughts and famine are much more common than they need to be. In Ethiopia, the World Bank estimates that "unmitigated hydrological variability increases poverty rates by about 25 per cent and costs the Ethiopian economy about 40 per cent of

its growth potential." Investment in dams is of particular importance to the poor, as these people typically have less access to the resources necessary to carry them through droughts and floods (World Bank, 2006). The same suite of considerations also applies to the provision of safe drinking water and adequate sanitation – one of the foci set for the MDGs.

Figure 4. Relationship between rainfall and GDP growth in Ethiopia



Source: World Bank (2006).

There have been a number of attempts to model the likely impacts of taking a green approach to economic development. "Green growth" is defined by the OECD as "promoting economic growth while reducing pollution and greenhouse gas emissions, minimising waste and inefficient use of natural resources."[7] UNEP has modelled prospects to 2030 and 2050 of increasing investment in the world's water and other renewable sectors by 2 per cent of GDP and compared it with a business-as-usual scenario that invests the same amount of money uniformly across all sectors. The results show that by investing 2 per cent of GDP only in water and other renewable resource sectors – a green growth scenario – the need for investment in the water services sector reduces as it becomes more efficient and the relative size of this water resources sector becomes smaller in a manner that enables faster growth in other sectors. When all this comes together the rate of economic growth is greater than under the business-as-usual scenario! Significantly, the improvement in water use efficiency coupled with clear signaling of the value of water also means that water consumption is kept within sustainable limits. Under the business-as-usual scenario, however, water resources continue to decline (Young, 2013).

The International Food Policy Research Institute (IFPRI), working in partnership with Veolia Water, reports a similar story (see Veolia Water, 2014). Early and timely investment in the development of sustainable approaches to water management can be expected to "de-risk" exposure to water scarcity for around one billion people by 2050, increase global GDP by around $17 billion and offer

[7] See www.oecd.org/investment/green.htm.

important societal and health benefits. Collectively, these studies and others like them are revealing that development opportunities are faster if priority is given to investments in the water sector and countries pursue, what FPRI calls, a “blue” pathway.

In summary, the return to investment in water security and governance arrangements that decouple water service provision from financial assistance can be high in both the short and long term.

3.1 Managing water scarcity

We now turn to the issue of managing water scarcity and the role of fiscal instruments in improving its management. As noted in the introduction to this paper, the need to manage water scarcity is increasing and being challenged by the changing nature of demand and supply conditions. In essence, there are three ways that scarcity can be managed:

1) Governments can use regulations to restrict who, where and when water can be used;
2) Prices and charges can be set administratively so as to guide water use and investment in activities that use water;
3) Robust water entitlement and allocation arrangements can be structured so that market-like water trading arrangements can be used to adjust water use.

Each of these approaches is assisted by the introduction of meters so that the quantity of water used by each user can be tracked and either controlled or charged for (see Olmstead & Stavins, 2008).

When water is abundant, usually, the first regulatory approach is most common. In practice, it serves as a precautionary measure that enables transition to the second or third approach as water scarcity problems start to emerge. Too often water scarcity emerges quickly and hence it is common for governments to use regulatory approaches to conserve water during a drought by, for example, banning the watering of gardens, among others. This approach, however, tends to impose high opportunity costs on users. During a recent drought in Sydney, for example, restrictions on water use cost users much more than would have been the case if a mix of pricing and regulatory measures had been used (Grafton & Kompas, 2007).

Recognizing the high costs of water use restrictions, economists routinely recommend that use of scarcity pricing is more efficient. Most, if not all, governments are adverse to the use of scarcity prices as a means to control use because the need to increase prices normally coincides with periods of extreme scarcity. As a result, there is increasing interest in the third option, which involves the use of market-like trading arrangements.

Box 5: Australian water reform experience

Australia began to realize the need to place limits on the quantity of water that could be taken for consumptive purposes in the late 1980s and placed a cap on the maximum amount of water that could be taken from the Murray Darling Basin's surface water resources in 1994. Rather than freezing the current allocation regime, at the same time, it introduced a national requirement that it be possible to trade water licences.

This early commitment to make it possible to trade water licences was followed by the unbundling of licences into entitlement shares, periodic allocations and separate controls on use. This led to the development of water-sharing plans, the purchase of water entitlements for the environment and, also, investment in programs that resulted in the re-assignment of water shares to the environment.

Today, water rights are defined as a perpetual entitlement to a share of all allocations made. This sharing arrangement extends to include urban water users, and there is a requirement for any town or city that aspires to more water to do so by purchasing entitlements and/ or allocations from existing shareholders.

The collective result of these reforms has dramatically improved water use efficiency and community resilience to drought. During a recent near decade long drought, for example, while the volume of water available for use dropped by two thirds, the value of agricultural production from irrigation fell by less than 20 per cent. Water allocations trade on a daily basis and prices change continuously in response to changing product prices and weather. Entitlement share prices respond more slowly and tend to reflect changes in costs associated with the adoption of new technology and long-term market expectations.

Sources: Young (2014a,b); Young (2009).

Water trading arrangements have been used for centuries in the Fulaj systems found in the Middle East and Asia. As with the newer sharing systems now being used in countries, such as Australia, these systems rely on the capacity for people to trade opportunities to access scarce water resources on a daily basis. Empowered water users are then able to make rapid decisions in a timely manner, and during periods of extreme scarcity they become extremely innovative. Knowledge is shared efficiently and adjustment occurs on a daily basis (Young, 2014a). Conversion of an existing water entitlement and allocation system to one that can take full advantage of a bottom-up, market-like trading process, however, is a complex process requiring careful attention to the way that entitlements are specified, allocations are made and robust governance arrangements are put in place (Young, 2014a). Building on experience with the use of market-like mechanisms in other sectors, Australia is one of the few countries in the world that has been prepared to transform its water licensing and allocations arrangements into one that allows the relatively unfettered use of water trading as a means to improve investment in water use.

The Australian approach involves the use of an independent planning authority to set sustainable diversion limits, the definition of entitlements as perpetual shares and coupled with a commitment to make allocations only in proportion to the number of shares held. In some systems, shares are grouped into priority classes so that all users have an opportunity to manage supply risks by choosing the portfolio of high and general security shares that best meets their needs. One of the key features of this approach is a decision to limit the number of shares that may be held. When the total number of shares in a system is limited, any user who wishes to hold a larger share must find someone who is prepared to accept a smaller share.

From a fiscal perspective, one of the more interesting attributes embodied in this sharing framework is an arrangement that allows shares to be mortgaged. As a result of this innovation, the financial sector has underwritten more private investment in the development of a more efficient way to manage Australia's water resources than otherwise would have been the case (Young, 2009).

Reflecting a market-based assessment of the merits of this approach, Bjornlund, Wheeler and Rossini (2013) have estimated that during the first decade of implementing this regime, the internal rate of return from holding water shares averaged around 20 per cent per annum.

3.2 Managing water pollution

As with the cost of service provision, economic theory predicts that water use will be more efficient if pricing arrangements reveal the full cost of externalities. Classic economic theory suggests that where an externality exists, the polluter should be taxed at a rate equivalent to the marginal cost of the damage imposed on other people. That is, polluters should be made to pay for the cost of the damage they cause.

As with scarcity pricing, governments find it difficult to use pollution charges as a means to improve water use and, typically, prefer to rely upon regulations to improve water quality. Where pollution-load monitoring arrangements are in place, there has been considerable success in developed countries with the use of load-based licensing arrangements, which, once in place, can be used to develop pollution permit trading arrangements. One of the more recent innovations in this policy space is the recent decision in the United States to expand nutrient trading in Chesapeake Bay. This program, which now involves four states, aims to reduce nutrient pollution in Chesapeake Bay by setting an administrative limit on emissions of nitrates and phosphates, issuing permits in proportion to this limit and then allowing firms to keep use within limits. As with water quantity trading, nutrient trading is producing considerable benefits that have not been obtained via other mechanisms.[8]

4. The influence of indirect fiscal instruments on water consumption

When discussing the role of conventional fiscal instruments on water use, a distinction can be made between countries that set absolute limits on water use and those that leave a combination of price and regulatory arrangements to determine how much water is used. In the case of the former, fiscal arrangements influence the distribution of water among users but not the absolute amount of water used. In the latter, prices affect both the distribution of water use among sectors *and* the total quantity of water used.

[8] The World Resources Institute reports that it has been able to identify 57 water quality trading programs worldwide. Of these, 26 are active, 21 are under consideration or development, and 10 are inactive or are completed pilots with no plans for future trades. The majority of programs were located in the United States, with only six programs existing outside the United States – four in Australia, one in New Zealand, and one in Canada. See www.wri.org/publication/how-nutrient-trading-could-help-restore-chesapeake-bay.

Box 6: Groundwater depletion in India

For many years, irrigators have been given either free or highly subsidized access to the electricity they use to drive groundwater pumps. As a result, in states like Punjab and Gujarat, there has been serious groundwater depletion. Recognizing that groundwater depletion is not sustainable, several governments have tried, unsuccessfully, to begin charging irrigators for the cost of the electricity they use. Every government that has attempted to do this, however, has lost power to one prepared to continue to provide irrigators access to electricity for free. Several governments have also tried, unsuccessfully, to place limits on groundwater use.

In an attempt to get around this problem, during 2003–2006, the Gujarat government began separating the grid used to supply electricity to villages from the grid used to supply electricity to irrigators. Once separated, groundwater pumping can be restricted by switching off the rural supply for extended periods without any adverse effect on electricity supply to villages. This second-best approach has gained political acceptance.

By 2006, power supply to 18,000 villages in Gujarat had been separated from the rural grid. Under the new arrangement, villages receive continuous metred access to a three-phase power supply, and tube well owners receive eight hours per day of power on a pre-announced schedule. Shah and others (2008) report that this approach has "radically improved the quality of village life, spurred non-farm economic enterprises, halved the power subsidy to agriculture, and reduced groundwater overdraft." They also report that, in the short-term, impacts on medium and large farmers have been mixed.

Farmers with access to a tube well have a much restricted opportunity to pump water but an increased opportunity to sell water to others as the price of water sold to people without access to a tube well has increased by 30–50 per cent.

Source: Shah et al.(2008).

4.1 Grants and subsidies

From a fiscal policy perspective, the provision of grants and subsidies to other water-related sectors can have extremely perverse effects on water management. There are many examples of such arrangements. From an agricultural perspective, two of the best known examples are the provision of subsidized electricity to farmers in India and Mexico.

In India, many farmers are given free access to electricity to pump groundwater, and as a result there is massive underinvestment in water saving technologies and serious rates of groundwater depletion are occurring (see Box 6).

In Mexico, farmers are given access to electricity at one third its full cost and, as is the case in India, serious groundwater depletion problems have been emerging. In addition, land subsidence caused by groundwater over-use is causing extensive damage to nearby roads and urban buildings. As a result – and also because of the adverse effects on the sustainability of groundwater – Guevara-Sanginés (2006), in a report to the United Nations Development Program, recommended the decoupling of electricity subsidy arrangements available to farmers. Decoupling involves payment of an untied cash grant to irrigators that is equivalent to the subsidy each would have received. Each irrigator is then free to choose how much to spend on pumping water. Decoupling can be phased in over a number of years. Assessing some of the implications of this decoupling, Figure 4 shows that as subsidies are reduced and decoupled payments are increased – farmers respond by investing in more efficient irrigation technologies. As this transition occurs farmers adopt more efficient

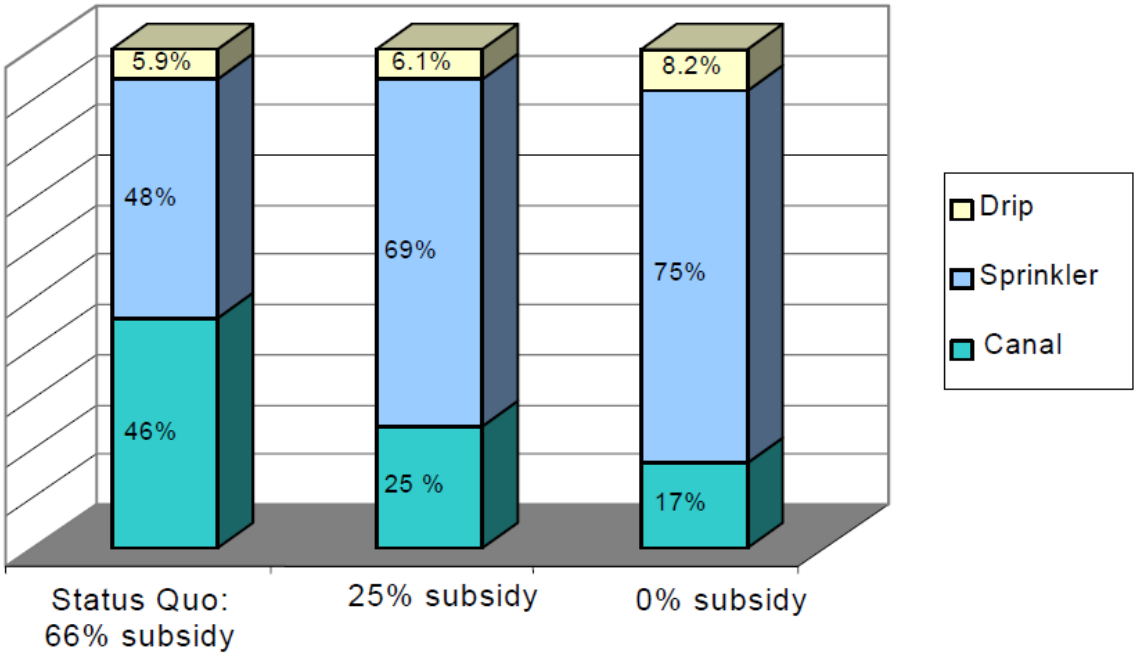
technology and, as a result, take less and less water. In Mexico, the result, according to Guevara-Sanginés (2006), would be sufficient to bring some aquifer use back into equilibrium and buy time for many others.

During periods of short-term water scarcity (e.g. drought) it is common for governments to offer drought subsidies. These subsidies take many forms and depending upon their nature have varying effects. When offered in the form of untied income support and/ or grants to assist farmers to relocate, the effects can be positive. When offered as an input subsidy, however, three adverse effects can be observed (McColl & Young, 2005).

The first adverse effect is an increase in water use. The second adverse effect is a behavioural signal that discourages farmers to plan for drought. The third adverse effect is more subtle but worthy of careful consideration. Droughts, especially when they start to become a regular event, indicate a need to change the way resources are being used. In developed countries, change typically involves considerable structural adjustment. Australian research reveals that drought subsidies seriously impede the structural adjustment necessary to retain regional viability.

In urban environments, subsidies to encourage adoption of more efficient toilets and watering systems have played a significant role, in combination with strong restrictions on use, in the management of severe urban water shortages. Using a combination of persuasive, regulatory measures and payments designed to encourage households to install water-saving devices, such as dual flush toilets, low volume showerheads and drip watering systems, among others, the City of Brisbane, Australia was able to reduce water use from 292 litres per person per day to around 140 litres per person per day. It is interesting to note that with the removal of water restrictions household water use has remained 30 per cent lower than it used to be because the benefits of more efficient water appliances persist. As a direct result of the programs put in place during the so-called “millennium drought,” this city’s capacity to deliver savings of the form realized in Australia’s millennium drought probably cannot be replicated. Considerable “demand hardening” has occurred. In the case of Brisbane, the opportunity to reduce the impact of a drought by encouraging households to invest in the use of more efficient water appliances has now passed.

Figure 5. Changes in the use of irrigation technologies as subsidies are replaced with a decoupled income payment so that farmers receive the same income



Source: Guevara-Sanginés (2006).

4.2 Taxation instrument

The general literature on the indirect effects of tax instruments on resource use and the environment is broad (Kosonen & Nicodème, 2009) and draws attention to:

- The double dividend that occurs when environmental taxes are used to reduce the need to tax other more desirable activities (e.g. labour);
- Tax interaction, that is, the effect of one tax or charge on other taxes.

Conceptually, taxes on goods and services other than water reduce the relative cost of water and, hence, increase its use.

As a general rule, most taxation arrangements have complementary effects on water use because they seek to expedite investment in water saving technologies.

The use of income taxation instruments to influence water use and, more particularly, investment in water related infrastructure is common in developed countries but less so in developing countries where most water users pay little, if any, income tax. Nevertheless, fiscal instruments such as these can have a significant influence on water use and are commonly used to speed the adoption of water saving technologies both by households and in the irrigation sector. During its recent decade-long drought, for example, the Australian government introduced an array of special income tax deduction concessions designed to encourage irrigators to adopt more efficient water using technologies. Special income averaging arrangements were put in place to deal with unexpected fluctuations associated with rapid shifts in gross income.

Special arrangements, such as the provision of an opportunity to deduct from income the full cost of investments in water saving infrastructure in a single year as opposed to allowing it to depreciate over a number of years, can have significant budget implications that are rarely transparent to the

public. They can, however, represent a significant subsidy. When fiscal incentives such as these are in place, they can be used to expedite change. Once established, however, their influence on water use declines and often becomes counter-productive as access to the subsidy becomes factored into land prices. As reasoned by the OECD in its formal definition of the Polluter-Pays Principle, there is a transitional case for the use of fiscal incentives to speed adoption of a new policy. Where there is a case for expediting change and increasing acceptance of a new regime, the magnitude of a subsidy can, for example, be reduced by say, 20 per cent per annum so that at the end of five years it is phased out.

The administrative cost of using different forms of fiscal instruments also requires consideration. The majority of the administrative costs associated of complying with general income taxation arrangements are borne by households and business. Unless recovered from users, however, a considerable proportion of the cost of collecting direct input taxes, charges and subsidies is borne by governments.

5. Concluding comments

Opinions about the best way to manage water resources tend to be deeply entrenched. This paper finds that the provision of affordable drinking water and sanitation services would be better if users are required to pay the full cost of service provision and the assistance needed to make it possible for people to afford water that is supplied using separate fiscal instruments. In order to reduce the potential adverse impacts of increasing water scarcity on economies, the development of more robust abstraction licensing regimes is suggested. Finally, it is suggested that, as far as possible, subsidies should be used as a mechanism to speed the transition to more sustainable arrangements and that perverse subsidy arrangements should be phased out. When and where ongoing financial assistance is justified, every effort should be made to decouple this assistance from arrangements that affect water use.

Building capacity to make greater use of fiscal instruments and the governance arrangements needed to develop robust abstraction regimes is critically important in the pursuit of water security. Excellence in policy design is of minimal benefit if not underpinned by excellence in governance.

Fiscal and environmental policy discussions around this and other points have led to broader discussions about the benefits of distinguishing between policies that impede, facilitate and expedite structural adjustment during periods of resource scarcity (McColl & Young, 2005). As a general rule, structural adjustment tends to increase prospects for more sustainable economic development. From a water scarcity perspective, restrictions on water trade impede structural adjustment. Policies that send clear signals about the value of opportunities to use water tend to facilitate structural adjustment. Policies that expedite structural adjustment, such as a once-off grant for investment in water-saving technology, can produce significant short and long term savings.

Overall, experience with the greater use of fiscal policies in water management is positive. Several studies demonstrate that transformational policy reform of water policy is possible. First and foremost, the case for change needs to be demonstrated and understood by the public. Second, interest and support from the beneficiaries of the proposed reform have to be secured.

References

Bitran, G., & Arellano, P. (2005). *Regulating water services, sending the right signals to utilities in Chile. Public Policy for the Private Sector*[Note number 286, March] World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/11229.

Bjornlund, H., Wheeler, S.,&Rossini, P. (2013). Water markets and their environmental, social and economic impact in Australia. *Water Trading and Global Water Scarcity: International Experiences*. Retrieved from

Das, B. et al. (2010). *Sharing the Reform Process: Learning from the Phnom Penh Water Supply Authority*. Gland, Switzerland: IUCN. Available from http://cmsdata.iucn.org/downloads/phnom_penh_waterfinal.pdf.

Dharmaratna, D., & Parasnis, J. (2010). *An analysis of the cost structure of water supply in Sri Lanka.* (Discussion Paper DEVDP 10/06) Monash University, Business and Economics Development Research Unit. Available from www.buseco.monash.edu.au/units/dru/papers/working-papers-10/1006analysisdharmaratnaparasnis.pdf.

Fournier, V.,et al. (2013). Palyja "water for all" programmes in western Jakarta. In *Investing in Water for a Green Economy: Services, Infrastructure, Policies and Management*, edited by Mike Young and Christine Esau. New York: Routledge.

Grafton, R. Q., & Kompas, T. (2007). Pricing Sydney water. *Australian Journal of Agricultural and Resource Economics*, 51(3), 227-241.

Guevara-Sanginés, A. (2006). *Water subsidies and aquifer depletion in Mexico's Arid Regions. Human Development Report 2006*, [Occasional Paper No. 2006/23] Human Development Report Office Occasional Paper No. 2006/23. Retrieved from http://hdr.undp.org/sites/default/files/guevara-sangines_alejandro.pdf.

Hearne, R. R., & Donoso, G. (2005). Water institutional reforms in Chile. *Water Policy*, 7, 53-69.

Kosonen, K., &G.J.A. Nicodème, G.J.A. (2009). The role of fiscal instruments in environmental policy. [Working Paper No. 2719] CESifo. Retrieved from https://ideas.repec.org/p/ces/ceswps/_2719.html.

McColl, J.C., &Young, M.D. (2005). Managing change: Australian structural adjustment lessons for water. [Report No. 16/05] CSIRO Land and Water. Retrieved from www.myoung.net.au/water/publications/managing_change_tr16-05.pdf.

Organisation for Economic Co-operation and Development (OECD) (2012). *OECD Environmental Outlook to 2050: The Consequences of Inaction.* Paris: OECD.

Olmstead, S. M., & Stavins, R. N. (2008). *Comparing price and non-price approaches to urban water conservation*. [Working Paper No. 14147] National Bureau of Economic Research (NBER). Retrieved from www.nber.org/papers/w14147.

Shah, T.,et al. (2008). Groundwater governance through electricity supply management: assessing an innovative intervention in Gujarat, western India. *Agricultural Water Management*, 95(11), 1233-1242.

Veolia Water (2014). Finding the blue path for a sustainable economy. [White paper]. Available from www.veolianorthamerica.com/sites/g/files/dvc596/f/assets/documents/2014/10/19979IFPRI-White-Paper.pdf.

Whittington, D., et al.(2015). A diagnostic tool for estimating the incidence of subsidies delivered by water utilities in low- and medium-income countries, with illustrative simulations. *Utilities Policy*, 34(June),70-81.Williams, S., and Sarah Carriger (2006). *Water and sustainable development: lessons from Chile.* Global Water Partnership, Policy Brief 2, Technical Committee (TEC). Retrieved from www.gwp.org/Global/ToolBox/Publications/Policy Briefs/02 Water and sustainable development. Lessons from Chile %282006%29 English.pdf.

World Bank (2006). *Ethiopia: Managing Water Resources to Maximize Sustainable Growth*. [World Bank Report No. 36000-ET]. Washington D.C.: World Bank Retrieved from http://siteresources.worldbank.org/INTWRD/Resources/Ethiopia_final_text_and_cover.pdf.

World Bank (2007). *Cost of Pollution in China: Economic Estimates of Damage*. Washington D.C.: World Bank. Retrieved from http://siteresources.worldbank.org/INTEAPREGTOPENVIRONMENT/Resources/China_Cost_of_Pollution.pdf.

World Health Organization (WHO) (2014). *Preventing Diarrhoea Through Better Water, Sanitation and Hygiene: Exposures and Impacts in Low-and Middle-income Countries*. Geneva. Washington D.C.: World Bank. Retrieved from http://apps.who.int/iris/bitstream/10665/150112/1/9789241564823_eng.pdf?ua=1/&ua=1.

World Health Organization (WHO), & United Nations Children's Fund (UNICEF) (2014). *Progress on Drinking Water and Sanitation: 2014 Update*. Geneva: WHO. Retrieved from http://apps.who.int/iris/bitstream/10665/112727/1/9789241507240_eng.pdf?ua=1.

World Health Organization (WHO), & UN-Water (2014). *Investing in Water and Sanitation: Increasing Access, Reducing Inequalities*. UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) 2014 Report. Geneva: WHO. Retrieved from http://apps.who.int/iris/bitstream/10665/139735/1/9789241508087_eng.pdf?ua=1.

Young, M. D. (2009). The effects of water markets, water institutions and prices on the adoption of irrigation technology. In *The Management of Water Quality and Irrigation Technologies*, edited by Jose Albiac and Ariel Dinar. London: Earthscan.

Young, M. D. (2013). Investing in water services, infrastructure, policies and management. In *Investing in Water for a Green Economy: Services, Infrastructure, Policies and Management*, edited by Mike Young and Christine Esau. New York: Routledge.

Young, M. D. (2014a). Designing water abstraction regimes for an ever-changing and ever-varying future. *Agricultural Water Management*, 145, 32–38.

Young, M. D. (2014b). Trading into trouble? Lessons from Australia's mistakes in water policy reform sequencing. In *Water Markets for the 21st Century: What We Have Learned?* K. William Easter and Qiuqiong Huang, eds. Boulder: Westview Press.

Young, M., & McColl, J. (2005). Defining tradable water entitlements and allocations: a robust system. *Canadian Water Resources Journal*, 30(1), 65-72.

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