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Fiscal Instruments and Water Scarcity

Mike Young (University of Adelaide)

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Fiscal Instruments and Water Scarcity

Research paper prepared for the Green Growth Knowledge Platform

by

Professor Mike Young
Faculty of Professions,
The University of Adelaide,
Adelaide
Australia 5000

Email: Mike.Young@adelaide.edu.au

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Executive Summary

When it comes to the relationship between fiscal policy and water, three issues come to the forefront. The first is the vexed question of how to charge for water services in both urban and rural environments. The second is the question of how to prevent water scarcity from undermining opportunities for economic progress. The third is the question of how to curtail the adverse effects of some fiscal policy arrangements used in other sectors on water consumption.

More generally, many of the arrangements associated with water use are not working well Reports of under-investment in infrastructure and failure to adequately maintain infrastructure are common. Acute examples of excessive groundwater depletion, water body contamination and loss of environmental services associated with water can be found in many countries. At the same time, global models of the world's economies are showing that by policy improvement coupled with increased investment in the water sector will speed economic progress – especially in developing countries.

One of the key causes of the long list of problems identified is a failure to send clear signals about the value of water and opportunities to make better use of it. Fiscal policy can be the friend rather than the foe of inclusive forms of development.

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. When one looks carefully at current subsidy arrangements, it becomes clear that they tend to be very poorly targeted and typically work more for the interests of middle and upper income people than for the poor and disadvantaged.

In a decoupled water pricing environment, there is a double dividend.

1) Benefits flow from a transition to arrangements that enable costs of infrastructure provision to be fully funded and, hence, many more people can be given affordable access to water services.
2) Assistance to the poor can be much more effectively targeted and, hence, more economic progress achieved. Subsidized access to water is no-longer provided to middle and upper income households. The resultant savings become available for use in other sectors.

As populations grow and regions develop, water scarcity is becoming increasingly common. By 2050, much of the world will be living in areas where demands 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 upon the degree to which scarcity costs are revealed.

In essence there are two ways to reveal scarcity. Either a) a scarcity price has to be added to water service charges or b) a sustainable limits have to be set and market processes left to send about the values of opportunity costs associated with water scarcity. Direct scarcity pricing by governments is rare. When a sustainable limit is not set, the default position involves expensive regulation, supply failure, resource degradation, etc. which all come at the expense of economic progress.

Global experience is showing that it is possible to set a supply limit, put in place a robust abstraction regime and the rely upon water trading arrangements to keep water use within affordable limits. Well designed, robust abstraction regimes speed innovation and promote investment. Examples of success with this latter approach can be found in developed and developing countries.

The last policy opportunity identified in this paper is the development of approaches that reduce the potentially adverse effects of other fiscal policies on water consumption. When a sustainable limit is set and enforced, adverse effects can be controlled. When they are not shielded in this manner, the suggestion is that efforts could be made to redesign these instruments so that they do not have adverse effects on water. An opportunity to use fiscal policy to expedite progress towards more sustainable forms of water use is identified.

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Fiscal Instruments and Water Scarcity

1. Background

This paper searches for insights into ways to improve the role of fiscal instruments and approaches in the management of water scarcity and pursuit of inclusive development objectives.

Water has a number of characteristics that make it politically difficult to manage. As Muller[1] observes, often surface water management involves "working with a fugitive renewable resource whose availability and variability is extremely unpredictable and varies over daily, seasonal, annual and multi-annual time frames." Generalizations need to be made with care. There are considerable differences between surface and ground water sources. Care also needs to be taken to understand the difference between arrangements most appropriate for the provision of water access to households, for irrigation and to industry.

Water policy discussions are complicated further by the fact that water is both a public and a private good. Typically its supply and treatment is most efficiently provided by a monopoly. Finally, water is a fugitive resource in the sense that it is difficult to ascribe ownership to it. Opportunities to use volumes of water can be assigned but that is as far as ownership gets. Much water, once used, is returned back to the system from which it was taken for use by others. The actions of one water user can have serious contamination and supply implications for many other users.

Against the above backdrop, this paper focuses on opportunities to use and improve the use of fiscal policy arrangements in the provision of access to water and the management of water scarcity. It is recognized that social views about the most appropriate way to supply and manage water are strong.

1.1. Outline

The paper begins with a number of definitions needed to bring clarity to the discussion. The potential of fiscal policy reform and investment in water is then examined. The paper then turns to the politically important issue of how to make water services available to all at an affordable price and follows with consideration of the role of fiscal policy in managing water scarcity. It closes with a broader consideration of the effects of fiscal policies used in other sectors on water use.

1.2. Fiscal policy

Broadly, fiscal policy is about the various ways that governments choose to collect and spend money. Fiscal policy arrangements are used to collect revenue via a raft of taxation, charging and pricing mechanisms. A range of expenditure, grant, subsidy and payment mechanisms is then used to spend this money.[2]

The influence of fiscal policy on water use can be both direct and indirect.

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[1] Muller, Mike (2014) A more useful agenda for water management. *New Water Policy and Practice 1(1):4-19*.

[2] For simplicity, we begin by assuming that water policy decisions have little influence on monetary policy the effects of monetary policy on water use are assumed to be constant. We acknowledge that is possible for governments, for example, to issue bonds, as Ethiopia has done to fund water infrastructure. Ethiopia is seeking to raise 20% of the money needed to fund construction of the Grand Renaissance Dam through a bond issue.

South Africa's decision to provide many of its people with free access to sufficient water to meet essential human needs is an example of a fiscal policy in the form of a subsidy with direct consequences for government budgets and water use.

The decision to provide free access to electricity in some parts of India and allow farmers to use this electricity to pump groundwater is known to be causing unsustainable groundwater depletion, is an example of an indirect effect (see Box 1).

Box 1

Groundwater depletion in India

For many years, irrigators have been given either free or highly subsidised access to the electricity they use to drive groundwater pumps. As a result, in States like Punjab and Guragat, there has been serious groundwater depletion. Recognising 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 Guragat government began separating the grid used to supply electricity to villages from the grid used to supply electricity to irrigators. Once separated, ground water 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 Guragat had been separated from the rural grid. Under the new arrangement, villages receive continuous metered access to a three-phase power supply and tube well owners receive 8 hours per day of power on a pre-announced schedule. Shah *et al.* (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."

Assessment of the benefits of this approach depends upon the question of whether or not the most appropriate benchmark for assessment. In the short-term, Shah *et al.* (2008) report that impacts on medium and large farmers have been mixed. Farmers with access to a tube well have a much restricted opportunity to use them which means that they can pump less water. At the same time, they have an increased opportunity to sell water as it has become scarcer. Under the new electricity rationing scheme regime, prices charged by tube well owners willing to sell water have increased by 30–50%. As a result, those who have to buy water have been made worse off. Shah *et al.* report that the majority of those who have to buy water are poor and have access to less land.

To date, little has been written on the relationship between fiscal policy and water policy. Typically, water issues associated with urban development and affordable access to clean water supplies are seen as separate from those associated with the management of access for irrigation, mining and other purposes. This paper tries to take a different pathway and search for guidelines that are universally applicable.

Fiscal policies are used to influence

- "demand for goods and services" – including demand for access to water;
- "private investment" – including investment in water supply and using technologies;
- "private savings" – including water that is stored for later periods and money put aside to assist during periods of drought; and
- the "distribution of income" by, for example, providing the poor with subsidized access to water.

Demand for goods and services and, also, the extent of private investment is heavily influenced by the extent and nature of public investment. In the water sector, the crowding out of private investment in the water service provision is common – especially when governments choose to provide these services at less than full cost.

A relatively unexplored issue from a water policy perspective is the interdependence of fiscal policy, monetary policy and water policy.[3] The focus of monetary policy is on the overall health of national economies while the focus on fiscal policy is on economic detail. Monetary policy is used, primarily, to maintain stable prices and through this facilitate economic development by controlling the supply of money and setting a reference interest rate. Water managers are rarely involved directly in monetary policy decisions but there are exceptions especially when it comes to the construction of large dams. Ethiopia, for example, has chosen to use a bond issue to help fund construction of the Grand Renaissance Dam on the Blue Nile.[4] Many developing countries have funded a considerable proportion of investment in dams through loans from international organisations such as the World Bank.

In addition, it needs to be recognized that a considerable proportion of international aid payments are linked to water projects. Donations, loans, etc. designed to assist with the provision of access to water can result in tensions between those responsible for the delivery of water services and those responsible for fiscal and monetary policy.

1.3. Water stress, water scarcity and water security

Modelling by many organisations including the OECD, the International Food Policy Research Institute (IFPRI) and the 2030 Working Group on Water is showing that pressure on water resources is such that the number of people living in association with a stressed water resource is about to double. Within a few years more than half the world's population will not have access to all the water they might aspire to use.[5] "The International Food Policy Research Institute (IFPRI) has estimated that 4.8 billion people – more than half the world's population – and approximately half of global grain production will be at risk due to water stress by 2050 if status quo, business-as-usual behaviour is followed. This IFPRI study also found that the flow-on effects of the mismanagement of water scarcity will place around 45%

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[3] Monetary policy deals with the big economic picture. Fiscal policy deals with the detail. For a useful overview of the interdependence of fiscal and monetary policy from the perspective of a member of the Governing Board of the Swiss National Bank, see Fritz Zurbrügg's November 2012 address to the University of Lucerne. (Available at http://www.snb.ch/en/mmr/speeches/id/ref_20121121_zur/source/ref_20121121_zur.en.pdf)

[4] When completed the Grand Renaissance Dam will be the largest hydropower dam in Africa. Ethiopia has announced that it intends to fund construction from its own sources and not borrow from other countries.

[5] Young, M.D. (2013) Investing in Water Services, Infrastructure, Policies and Management. In Young, M. and Esau, C. (eds) Investing in Water for a Green Economy - Services, Infrastructure, Policies and Management. Routledge, Milton Park and New York, 319 pages.

of global GDP ($63 trillion) at risk by 2050."[6] Figure 1 shows the current distribution of water scarcity around the world partitioned into regions where water is absolutely scarce and economically scarce. In areas, where water is economically scarce, supply can be increased by building more dams and more distribution systems.

These estimates, however, do not take account of parallel declines in water quality. Water can also be scarce because it is unfit for the purposes that people aspire or need to use it for. Drinking water is scarce in some parts of Bangladesh, for example, because it is contaminated by arsenic. The costs of cleaning polluted water supplies, typically, are very high. In China, the amount needed to clean-up all forms of pollution including water has been estimated to be in the vicinity of 2% of GDP.[7] Two-thirds of the China's rural population is without piped water, which contributes to diarrheal disease and cancers of the digestive system. The cost of these health impacts, if valued using a VSL of 1 million, are 1.9 percent of rural GDP

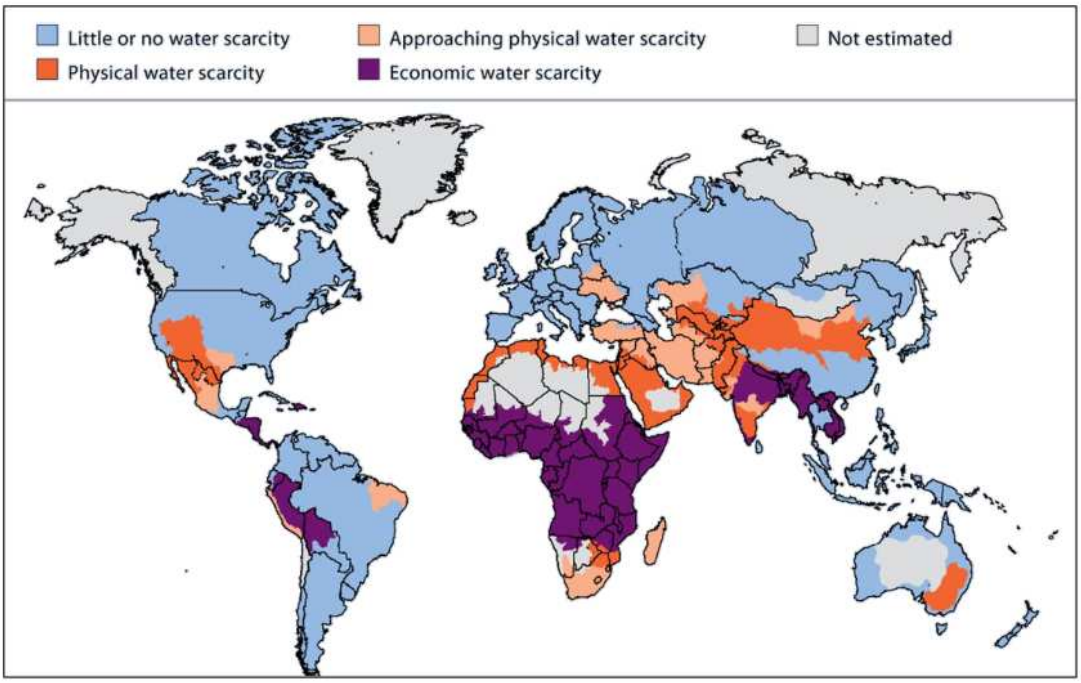

Figure 1 Areas of physical and economic water scarcity
Source: UNEP/GRID UNEP/GRID Arendal Maps and Graphics Library, 2008

6 Adapted from Global Blue's website, seehttp://growingblue.com/water-in-2050/ For a more detailed summary see Veolia Water (2014) Finding the Blue Path for A Sustainable Economy. Available at http://www.veoliawaterna.com/north-america-water/ressources/documents/1/19979,IFPRI-White-Paper.pdf

7 World Bank (2007) Cost of pollution in China: Economic estimates of damage. Available at http://siteresources.worldbank.org/INTEAPREGTOPENVIRONMENT/Resources/China_Cost_of_Pollution.pdf

2. Green growth and inclusive economy perspective

2.1. Water security and economic growth

There is mounting global evidence that failure to invest adequately in water infrastructure – *economic water scarcity* – is having a disproportionately high impact on opportunities for economic development. One of the best known examples of this phenomenon comes from Ethiopia.[8]

In most developed countries, investment in dams is used to manage seasonal variability and reduce the impacts of climatic variation. That is, investment in water storage arrangements typically, has been sufficient to smooth out much supply variability. In Africa and some parts of Asia and South East Asia, however, this investment still appears to be inadequate (see Figure 1). In Ethiopia, for example, there has been little investment in water storage and, as a result, food production is very variable. The World Bank estimates that "unmitigated hydrological variability increases poverty rates by about 25% and costs the Ethiopian economy about 40% of its growth potential." The World Banks points out that astute investment in dams is of particular importance to the poor, as these people typically have less access to the savings necessary to carry them through the droughts and floods that wipe out crops, etc.

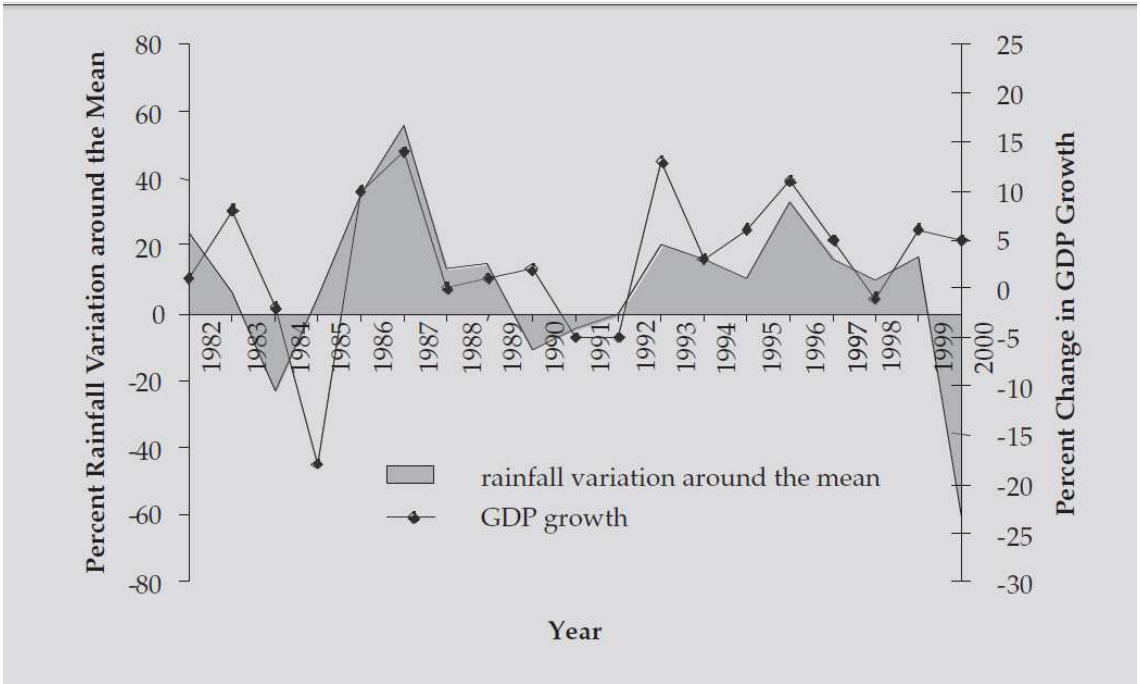

Figure 2 **Relationship between Rainfall and GDP growth in Ethiopia**
Source: World Bank (2006)

The same suite of considerations also applies to the provision of safe drinking water and adequate sanitation that is one of the foci set for the Millennium Development Goals. Frontier Economics,[9] for example, has estimated that delivery of these water goals would add more than 5% to annual GDP in Africa and Latin America. If universal access to safe drinking water and adequate sanitation was provided in these two continents more than 15% would

[8] World Bank (2006) Ethiopia: Managing Water Resources to Maximize Sustainable Growth. World Bank, Washington DC.

[9] Frontier Economics (2012) Exploring the links between water and economic growth: A report to HSBC.

be added to annual GDP. Recently, the World Health Organisation estimated that every $1 invested in improvement in the delivery of safe drinking water and adequate sanitation can be expected to return $4.30 in a typical developing country.[10]

2.2. Water and green growth

There have been a number of attempts to model the likely impacts of taking a green approach to economic develop. "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."[11] UNEP has modelled prospects to 2030 and 2050 of increasing investment in the world's renewable sectors by 2% of GDP and compared it with a scenario that spends the same amount uniformly across all sectors. The results show that by investing 2% of GDP only in renewable "green" sectors economic growth is greater and demand can be kept within sustainable limits. When people are freed from the costs of only have access to dirty water and/or expensive water to be carted to them, Two things happen. First, the poor have more time and access to the resources needed to escape from poverty. Secondly, the cost of water service provision to all declines and the water sector becomes smaller in a manner that further opens up opportunities for more inclusive forms of development.

The International Food Policy Research Institute (IFPRI), working in partnership with Veolia,[12] reports a similar story. Early 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 in 2050, increase global GDP by around US$17 billion and offer important societal and health benefits. Collectively, these studies and others suggest that those interested in economic development need to find what IFPRI calls a "blue" pathway. Rather than just spending money, this paper identifies the need for significant investments in the development of more effective water governance and pricing arrangements.

In summary, the return to investment in water security can be high in both the short and the long term.

3. Water pricing and charging

The literature on how to charge for access and use of water and water-based services and also on the best way to finance investment in the infrastructure used to manage water is complex and characterized by a considerable degree of conflicting advice. Much of the literature lacks rigour and, in particular, fails to pay sufficient attention to the question of who benefits most from the cross-subsidy arrangements buried in most water service charges and government contributions to water utility budgets.

A related consideration is the question of how water prices, charges and costs influence water use. Economic research around the world routinely finds that the water price elasticities in agriculture, in industry and in households are not zero. For the benefits from the clear signaling of the value of water prices to be realized, however, meters need to be in place. When and where meters are in place, opportunity costs can be revealed and demands for access reduced.[13] These same studies find that the responsive of water to price changes in more elastic in the long term than in the short term. That is, consumers are aware of the

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[10] World Health Organisation and UN-Water (2014) Global Analysis And Assessment Of Sanitation And Drinking-Water Report: Investing in water and sanitation: increasing access, reducing inequalities. World Health Organization. Available at http://apps.who.int/iris/bitstream/10665/139735/1/9789241508087_eng.pdf?ua=1

[11] http://www.oecd.org/investment/green.htm

[12] Finding the Blue Path for a Sustainable Economy: A white paper produced by Veolia Water. Available at

[13] See, for example, Olmstead, S.M. and Stavins, R.N. (2008) Comparing price and non-price approaches to urban water conservation. National Bureau of Economic Research Working Paper Series 14147. Available at http://www.nber.org/papers/w14147

size of their water bill and as it rises begin to search for ways to reduce use via investment in more efficient water saving technologies. Irrigators begin to replace flood irrigation techniques with drip irrigation techniques, businesses begin recycling water and households begin to install dual flush toilets,

Discussing the inter-dependence of monetary and fiscal policy, Zurbrügg explains that increasingly governments are moving towards a set of guiding policy principles so that businesses and households can plan and invest with greater confidence. When applied to water, one of the most obvious questions is that of whether or not equity considerations justify the provision of access to subsidized or even free water.

Access to water for essential services is a human right and it is well known that access to clean water and adequate sanitation is one of the most necessary preconditions for people to escape poverty. To this end, in 2008, the United Nations Office of the Commission on Human Rights appointed Ms. Catarina de Albuquerque a Special Rapporteur on the Human Right to Safe Drinking Water and Sanitation.[14] Understandably, water managers are being pressured to look after the interests of the poor. Water pricing issues are politically sensitive. The question of how to ensure that access to adequate water services is affordable cannot be avoided.

3.1. Increasing Block Tariffs

The most common water charging regime combine a fixed charge with a suite of variable charges per unit of water consumed that increase with total household use. When examined carefully, however, it becomes clear that the Tinbergen Principle has fallen from the attention of water managers. The Tinbergen Principle states that, if a nation is interested in dynamic resource efficiency then these nations should use a separate instrument for each policy objective. [15] That is, users should be required to pay the full marginal cost of supply and those who are needy assisted using a separate policy instruments specifically designed and targeted to support the needs of the needy. Chile is one of the few countries that takes this approach (see Box 2). Most countries, however, use an increasing block tariff arrangement that increases the amount paid per unit in a step-wise manner.

[14] See http://www.ohchr.org/EN/Issues/WaterAndSanitation/SRWater/Pages/SRWaterIndex.aspx

[15] Young, M.D. and McColl, J.C. (2005) Defining tradable water entitlements and allocations: A robust system. Canadian Water Resources Journal 30(1):65-72.

Box 2

Water charging in Chile

In Chile, most water supply and sanitation systems are operated through a company and financed ultimately through user fees. Rather than subsidizing access to water, the government operates a means-tested subsidy scheme whereby qualifying poor households to receive a subsidy administered by the municipalities. Under this arrangement, households can apply to have part of their water and sewage bill paid for them.

In effect, applicants are means tested and the scheme ensures that no more than 5% of household income is being spent on water. The Chilean water regulator is then left to set tariffs in a manner that sends clear economic signals about the value of water and the costs associated with supply and treatment. The resultant targeting of expenditure is much more efficient and, as a result, much more equitable.

Sources: Bitran and Arellano (2005);Hearne and Donoso (2005); and, also, Williams and Carriger

Under an increasing block tariff, typically the charge for the first volume used by a household is minimal but then increases in one or two steps as more and more water is used.

At first glance, the increasing block tariff approach seems fair and ensures that all have access to sufficient water for essential use. When analyzed carefully, as Whittington[16] and others have done,[17] inclining block tariff regimes fail to assist the poor and most disadvantaged. So much so, that in most cases, the majority of poor people would be better off, if they were required to pay the full cost of water delivery and the money currently used to subsidise water prices distributed to poor households via a direct payment, water bill coupon or other similar mechanism.

The reasons for this counter intuitive result arise from the fact that when modelled carefully much more benefit goes to middle and high income households because the subsidy applies to these households as well as the poor. In addition, it is worsened by the fact that as the cost of this subsidy normally comes from a government budget, often governments either cannot or are not prepared to provide the necessary subsidies. When this occurs, those not connected are forced to either cart water for themselves or purchase it at a very high unit cost from a water cart. In Jakarta, for example, the price paid by those without access to mains water is around 50 times higher than the full cost of supplying mains water.[18] In Nairobi, only half of residents are connected and those not connected are forced to pay 20 to 25 times the price paid by those with access to mains water.

In Panama in 2000, 16% of water users lived in poverty or extreme poverty while at least two thirds of consumers – mostly the middle class – received subsidized access to water.[19] That is, water charging arrangements, which were designed to be pro-poor, have ended up in the massive transfer of wealth to the middle class. Cross-subsidies of this form are common

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[16] Whittington, D.; Nauges, C.; Fuente, D. and Wu, X (2024) Estimating the Incidence of Subsidies Delivered by Water Utilities in Low- and Medium-Income Countries, with Illustrative Calculations. Environment for Development Discussion Paper Series, November 2014.

[17] Gómez-Lobo, A. and Contreras D. (2003) Water subsidy policies: A comparison of the Chilean and Columbian Schemes. *The World Bank Economic Review 17 (3):391-407.*

[18] Fournier, V.; Folliasson, P.; Martin, L.; Arfiansyah and Damayanti, I (2013) Palyja "Water for All" Programs in Western Jakarta. In Young, M. and Esau, C. (eds) Investing in Water for a Green Economy - Services, Infrastructure, Policies and Management. Routledge, Milton Park and New York, 319 pages.

[19] Foster, V.; Gomez-Lobos, A and Halpern, J. (2000) Designing direct subsidies for water and sanitation services. Panama: A case study. World Bank Working Paper No. 2243

when inclining block tariff structures are in place as middle class people tend to live in areas where there is a mains water supply and it is connected.

The guiding principle that emerges from the above considerations is that water use will be more efficient if water pricing and charging arrangements are used to send clear signals about the opportunity costs of using water and decoupled from pro-poor policy arrangements designed to lift out of poverty. Under such an arrangement, the provision of access can be decoupled from decisions about how much subsidy to provide. If this is done, the universal provision of access becomes possible as investments in the construction and maintenance of the necessary infrastructure can be funded fully from water charges and made irrespective of the question of which people need financial assistance. Significantly, those presently denied access and only provided with access to a poor quality service gain can be given access to a high quality service at a cost that is much less than they currently pay. Benefits flow from increased disposable income, the freeing of time no-longer needed to cart water and from improvements in health.

A related consideration is the cost of establishing a connection. From a fiscal perspective, **the case for subsidies is greatest when the subsidy expedites change and can be well targeted.** Arguably, one of the best opportunities to do this is to subsidize the connection process for poor households so that they can have ongoing access to water at the full marginal cost of ongoing supply coupled with all access to all the benefits that access to clean water brings. The main merit of this approach is that it speeds provision of access to disconnected communities.

4. Entitlement and allocation arrangements in the face of scarcity

Scarcity values take two forms. The first form relates to immediate demands for water which, for example, in a drought can be substantial. The second form relates to long term demands which, for example, occur when there is urban growth and the only available source of water is being and has been used for many years in agriculture. In both these situations, there are three choices:

1. Unsatisfied demands can be ignored and or met via the imposition of regulations in the form of bans on lawn watering, irrigation at certain times of the day, etc.
2. Administrators can redress the situation by transferring water from one sector or region to another.
3. Market-like processes can be used to encourage users to trade opportunities to use water with one another.

Arguably, of the three processes, the third approach which involves the use of market-like mechanisms is best able to represent ever-changing scarcity values and drive the innovation necessary to reduce the impacts of water scarcity. To be successful, however, considerable reform of abstraction entitlement and allocation arrangements is necessary. When implemented along the lines now used in Australia (Box 3) and which have been used for centuries in the Fulaj systems found in the Middle East and Asia, considerable efficiencies can be obtained.[20] Water is not an infinite resource. The Australian approach involves the use of an independent planning authority to set limits, the definition of entitlements as perpetual shares coupled with the regular release of tradeable allocations to shareholders as water becomes available. Shares are grouped into priority classes so that all users have an opportunity to manage risk. This, for example, enables cities on behalf of their residents to secure access to secure preferential access to water resources.

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[20] See Young, M. (2014) Designing water abstraction regimes for an ever-changing and ever-varying future. *Agricultural Water Management* 145:32–38.

Box 3

Australian water reform experience

Australia began to realise 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 shares, periodic allocations and separate controls on use. This lead onto the development of water sharing plans, the granting and purchase of water entitlements for the environment and entitlements.

Today, water rights 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%. 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 (2008)

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 much of the private investment made in the development of more efficient way to manage Australia's water resources.[21]

Reflecting a market-based assessment of the merits of this approach, Bjornlund, Wheeler and Rossini (2012) have estimated that during the first decade of implementing this regime, the internal rate of return from holding water shares averaged around 20% per annum.[22]

4.1. 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 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,

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[21] Young, M.D. (2008) The Effects of water markets, water institutions and prices on the adoption of irrigation technology. In Albiac, J. and Dinar, A. (eds) The Management of Water Quality and Irrigation Technologies. Earthscan: London pp. 227-248.

[22] Bjornlund, H., Wheeler, S., Rossini, P., 2012. Water Markets and Their Environmental, Social and Economic Impact in Australia, in Maestu, J. (Ed.), Water Trading and Global Water Scarcity. International Experiences. RFF Press/Taylor and Francis/Routledge, UK, pp. 68-93.

Naïve application of this principle in water pricing results in a uniform tax on all water users and the transfer of the resultant revenue to Government who in turn is expected to invest this revenue in ways that offset value of the resultant damage. This approach, however, is inefficient as it fails to grant each user an economic incentive to avoid causing the externality. As with the delivery of opportunity to the poor, externality management will be much more effective if separate instruments are used to send the necessary price signal. In some cases, a well enforced regulation will be sufficient. In other cases, a load-based charge will be optimal.[23]

5. The influence of fiscal instruments on water consumption

When discussing the role of conventional fiscal instruments in 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.

When and where-ever there is no regulated limit on the quantity of water that can be taken for consumptive purposes, the fiscal policy burden is greater as either governments need to set a scarcity price or use a mixture of regulatory arrangements to limit access.

The array of fiscal instruments used to influence water consumption and improvement include

- Income and capital gain taxes
- Goods and services taxes
- Direct subsidies paid in proportion to water used
- Indirect subsidies that reduce the cost of water use and/or pollution
- Production subsidies

The general literature on the effects of these instruments and national economies is broad.[24] From a natural resource and environmental perspective this literature draws attention to

- "Tax interaction" caused by effects that taxes have on real wages; and
- The "double dividend" that the recycling of environmental tax money reduces the need to tax other more desirable activities like labour.

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

The administrative cost of using different forms of fiscal instrument 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, a considerable proportion of the cost of collecting direct input taxes, charges and subsidies are borne by governments. As a general rule, most authorities argue that a mix of fiscal instruments should be used.

From a water security perspective, supply variability presents a major challenge for politicians. Droughts for example, can emerge quickly and require a rapid but politically unacceptable increase in a charge at the very time that users start to experience financial

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[23] It needs to be recognised, however, that pollution taxes when collected by a government allow reductions in the need to collect other taxes. To this end, it is possible to tax opportunities to pollute in a manner that achieves both objectives. The approach involves issuing entitlement shares in the pollution limit and then auctioning a proportion of each share holding.

[24] Kosonen, K. and Nicodème, G. (2009) The role of fiscal instruments in Environmental Policy. CESifo Working Paper No. 2710. Available at https://ideas.repec.org/p/ces/ceswps/_2719.html

hardship. This is, for example, one of the reasons that Australian Governments have redesigned the water licensing arrangements. Rather than setting a high scarcity charge, water allocations are have been made tradeable and during droughts the price of water increases rapidly. The scarcity price is revealed in the market rather than by governments a farmers decide how best to use a limited amount of water.. Those that decide to sell receive a high price and take this in compensation for the fact that they have to get by with less water.[25] As a general rule, when relative prices change quickly the use of market-based instruments instead of fiscal instruments makes the delivery of economic signals politically easier (see Box 3). This is one of the reasons why many environmental and natural resource economists advocate the use of market-based instruments for the management of resource scarcity and quality issues.

5.1. Taxation instruments

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, the issue is important. Preferential income tax concessions associated with water use are common in most developed economies 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 are in place to deal with unexpected fluctuations associated with rapid shifts in gross income. As a general rule, most of taxation arrangements have complementary effects on water use because they seek to expedite investment in water saving technologies.

Given the fact that around three quarters of the world's surface and ground water use is for agriculture, it is likely that taxation and international trading arrangements for agriculture and food have a significant impact on water use. In Europe and Australia, for example, a considerable proportion of food has a zero value added taxation rate. As a result, more water is used by European irrigators than otherwise would be the case. Exploring this issue using a General Equilibrium model,

Special arrangements, such as the opportunity to write off the full cost of investments in water saving infrastructure in a single year rather than over a number of years can have significant budget implications that are rarely very transparent to the public. When fiscal incentives like 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 annum so that, at the end of 5 years, it is phased out.

5.2. Grants and Subsidies

From a fiscal policy perspective, the provision of grants and subsidies 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 power to farmers in India and in Mexico.

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[25] Young, M. (2014) Trading Into Trouble? Lessons from Australia's Mistakes in Water Policy Reform Sequencing. Chapter 11 in Easter, W. and Huang, Q. (eds) Water Markets for the 21st Century: What we have learned? Westview Press, Boulder.

In India, many farmers are given free access to electricity to pump ground water and as a result there is massive under-investment in water saving technologies and serious rates of ground water depletion are occurring (see Box 1).

In Mexico, farmers are given access to electricity at one third its full cost and as is the case in India, serious ground water 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[26] in a report to the United Nations Development Program points out recommends the "decoupling" of electricity subsidy arrangements available to farmers. Decoupling involves payment of an untied cash grant to irrigators equivalent to the subsidy each would have received. Each irrigator is then free to choose how much to spend on pumping water . As shown in Figure 4, halving the subsidy, would reduce groundwater use by 19% and bring a significant proportion of the aquifers back into equilibrium.

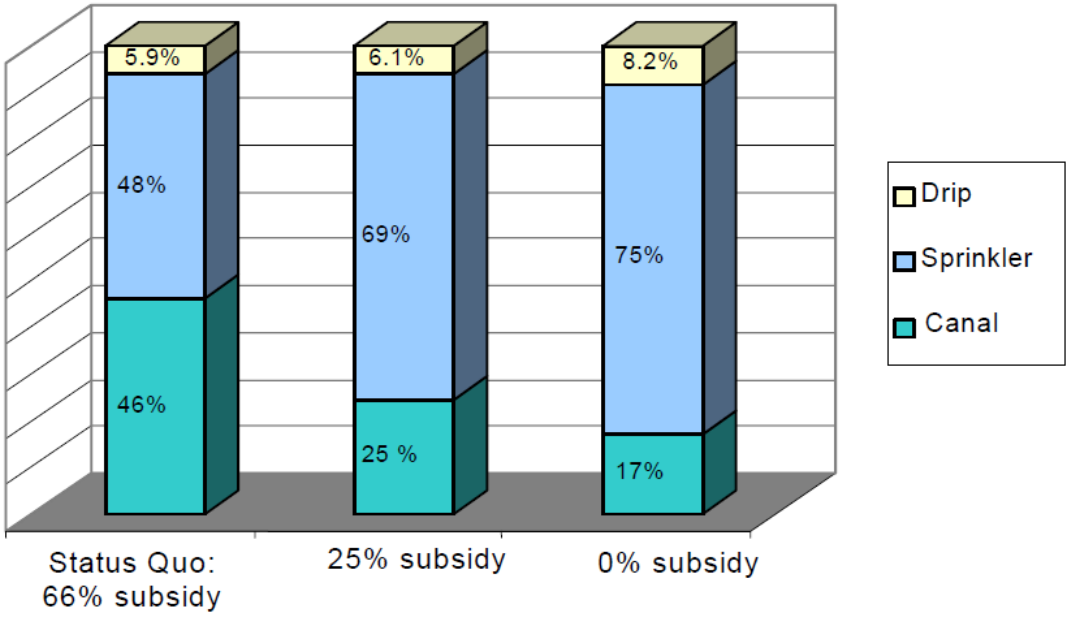

Figure 3 Distribution of irrigation technologies within COLPOS sample under different scenarios of subsidy decoupling
Source: Guevara-Sanginés (2006)

During periods of short term water scarcity -- 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.

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

[26] Guevara-Sanginés, A. (2006) Water Subsidies and Aquifer depletion in Mexico's Arid Regions. Human Development Report 2006 Human Development Report Office OCCASIONAL PAPER No 2006/23. Available at http://waterwiki.net/images/0/0a/WaterSubsidiesAndAquiferDepletionMexico.pdf

research reveals that drought subsidies seriously impede the structural adjustment necessary to retain regional viability.

Fiscal and environmental policy discussions around this point have led to broader discussions about the benefits of distinguishing between policies that impede, facilitate and expedite structural adjustment during periods of resource scarcity.[27] 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, 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.

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 like dual flush toilets, low volume showerheads, etc, 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, however, that with the removal of water restrictions, household water use has remained 30% lower than it used to be. As a direct result of the programs put in place during the 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.

6. Current policy positions, dilemmas and challenges

6.1. Factors affecting the broader use of fiscal approaches to the management of water scarcity

This paper advocates a shift towards the wider use of fiscal policy measures in water management and a reduction in the use of direct water pricing arrangements and licensing arrangements for the delivery of assistance to the poor. The exploration of pathways to the development of more robust abstraction licensing regimes is suggested. For some governments, this approach represents a significant shift and the development of different administrative capacities and new governance arrangements.

The phase out of perverse subsidy and pricing arrangements is particularly challenging. The research available suggests that once users become accustomed to the receipt of a subsidy, political opposition to its removal can be strong. Separation of the subsidies from water use affecting arrangements, sometimes called decoupling, can be a first step. qqq

The development of transformational policy reforms of this nature requires considerable skill and attention to the sequence of reforms and activities necessary to bring about a transformational policy shift. 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 has to be secured. One of the surprising policy mis-specifications reported in this paper is the role of increasing block tariff arrangements in assisting middle and even upper income households in ways that dis-advantage the poor. Once in place, arrangements like these can prove to be politically difficult to change.

Experience in the delivery of major fiscal reforms in water policy reform is limited. 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

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[27] McColl, J.C. and Young, M.D. (2007) Managing Change: Australian structural adjustment lessons for water. CSIRO Land and Water Report No. 16/05.

transformed. In the 1992, only 20% of residents had access and over 70% of water use was not paid for. Fourteen years later, over 90% of residents had access and that access was reliable. Non-revenue water had fallen to less than 6%. 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 hard with poor people to get them to argue for arrangements that got them connected over and above arrangements that favour 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.[28] In 2010, it was awarded the Stockholm Water Industry Award.

6.2. Ways forward

The way forward in the communication of the key messages set out in this paper requires careful consideration. As a general rule, the majority of water service utilities are owned by governments and, at present, few expect to be required to recover the full costs of service provision. Fiscal discipline will come if and only if those responsible for the management of government budgets demand it. Public demonstration of the benefits of such reforms is missing. Opinions about many water pricing practices are deeply entrenched. Careful research on best ways to communicate the resultant benefit message is necessary.

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.

[28] See Das, Binayak; Ek Sonn Chan, Chea Visoth, Ganesh Pangare, and Robin Simpson (2010) *Sharing the Reform Process: Learning from the Phnom Penh Water Supply Authority (PPWSA)* (Gland, Switzerland, 2010). Available at http://cmsdata.iucn.org/downloads/phnom_penh_waterfinal.pdf

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