

WATER MARKET INSTITUTIONS: LESSONS FROM COLORADO

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Important water issues in South Africa relate to equity, efficiency of use, quality (return flow pollution) and instream uses such as the environment. Farmers in South Africa pay water rates whether or not water is used and water is not volumetric priced. Water markets can attach an opportunity cost price and scarcity value to water. Opportunity cost pricing by the state has received no support in the international economic literature largely because of estimation problems. Water markets have started to emerge in the Lower Orange River and in the Fish and Sunday's rivers in the Eastern Cape in South Africa but there are two reasons why agricultural water markets do not release water in South Africa. The first reason is that the only water trades that have taken place in these rivers are between non-users of water and intensive users. It may take time before all sleeper rights (water not used) are activated which is also the case in Australia. Secondly, irrigation farmers in South Africa along the Orange and Sunday's rivers are permitted to irrigate a larger area if they adopt water saving technology such as drip irrigation. Although this water saving technologies will reduce water application per ha, the consumptive use of water per ha may not decrease and will increase if a larger area can be irrigated. Agricultural water markets are thus increasing the use of water and not promoting its conservation. It is thus recommended that transfers should be based on consumptive use if return flow is significant.

1. INTRODUCTION

The new SA Water Act of 1998 provides the constitutional framework for future water markets in South Africa. Although the main reason for the Act is to address the equity issue, other issues are also important for instance that the environment should be protected and that water should be used as a scarce resource by the agricultural sector. These issues are interrelated and not always mutually exclusive and water markets and water institutions may be used to promote economic and social desirable objectives.

Although technical water research has received high priority in the past in South Africa, little is known about the impacts of alternative water economic policies. South African water markets along with those of Australia and the Eastern USA are based on riparian ownership and are not as fully developed as those in the Western USA. Due to the scarcity of water in the Western USA, water markets have a long history of experience and dates back to a case by the Colorado Supreme Court in 1882 (Howe, 1998). The purpose in this research is to study the

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experience of successes and unresolved challenges of Western water markets, with possible lessons for South Africa. This paper draws on institutional economics and is of an interdisciplinary nature. Future expected water scarcity in South Africa can be tackled by building more dams (supply side approach) or the more economic efficient use (demand side approach) of water. The latter approach is followed in this paper.

2. WATER MARKET DOCTRINES

Water rights are generally based on one of three systems, public allocation, prior (appropriative) rights and riparian rights. Public allocation involves administered distribution of water.

Prior water rights as practised in the Western USA are established by actual use while a distinction is made between senior rights and junior rights. According to the priority system, rights first established are senior. Senior rights usually held by agriculture must first be satisfied. The priority dates, diversionary entitlement, point of diversion, and place and purpose of use delimit appropriative water rights (Huffaker & Whittlesey, 1995). The water rights institution provides certainty in supply as senior (prior) rights are fulfilled before junior rights. Based on temporal priority, a water user can be relatively certain about receiving water in a give year.

Riparian rights link ownership of, or reasonable use of water to ownership of adjacent lands while rights are a percentage of water available for irrigation. The structure of water rights spreads the risk of variability equally among shareholders.

The riparian doctrine only recognises rights of riparian landowners and the rights of other potential users are not protected by law. The new South African Water Act has changed this legal priority of rights and only water required to meet basic human needs and to maintain environmental sustainability will be guaranteed as a right (SA Water Law, 1998). Under the new SA Water Act, farmers will have to apply for licenses to use water. Licenses are not to exceed 40 years and water must be used beneficially.

Under Riparian Water Law farmers have water rights whether or not rights are exercised. SA farmers have to pay water rates on registered riparian land whether water was actually applied or not and it is unclear whether in the SA context non use will constitute beneficial use as is the case in Australia (McKay, 1999). That is Australian farmers retain licenses to unused water in spite of the condition that water must be beneficially used.

3. WATER MARKETS

Water can be priced either through (a) tradable water rights, (b) attempt to price at opportunity cost through administrative pricing or (c) some other costing such as actual operating cost. If water rights are transferable then the market attaches an opportunity cost to water which is the preferred strategy in international economic literature (Briscoe, 1997; Thobani, 1997; Anderson & Snyder, 1997; Livingston, 1995 and Howe, 1996). In the absence of a water market, the value of water is incorporated in the price of land and as no volumetric price is attached to water, no incentive exists to use water as a scarce resource.

3.1 Price attached to consumptive or diverted use

In response to an increase in the volumetric price of water the farmer may:

- (a) shift to crops that are more water efficient or higher valued,
- (b) continue with the same crop and acreage and apply less water, or
- (c) more water saving technology could be applied by moving from flood to drip irrigation.

Attaching a price to the volume of water applied may not reduce the consumption of water as no water is saved by adopting water saving technologies (point (c) above) according to some experts (Huffaker & Whittlesey, 1995 and Frasier, 1998). These experts contend that increased on-farm efficiency such as use of water saving technology creates the illusion of water conservation when, in reality, the consumptive (water taken up by plants) use of water may increase. In a hydrologic system, water not taken up by the plant will be returned to the basin or aquifer and be available for other users. Allowing farmers to irrigate a larger area if they use water saving technology such as drip irrigation leads to lower return flow and increased consumptive use of water. This is expected to happen in South Africa as farmers along the Sunday's and Lower Orange rivers are permitted to irrigate a larger area if water saving technologies are adopted (Armitage & Nieuwoudt, 1999). Citrus farmers along the lower Sundays River have switched almost entirely from flood to drip irrigation. Apart from the water saving from drip irrigation the main reason appears to be that flooding creates water logging which can be a problem in citrus orchards.

If the consumptive use increases then less water will be for other users. Although the opportunity cost price attached to the volume of irrigation water applied is increased in this case consumptive use is expected to increase. However, if a price is attached to consumptive use then the incentive will be given to economise on consumptive use by adopting technologies (a) and (b) above.

The transfer of water out of a system may affect other users of waters who are parties outside the transaction. While other users may be better off as a result of water trade, the concern is with them being adversely affected. These users may be (i) other consumptive users of water (such as farmers down stream) (ii) other non consumptive users such as the environment while (iii) the quality of the return flow may be affected.

3.2 Other consumptive water right holders

The transfer of water rights to another user may impact negatively on down stream users who are depended on the return flow of the previous use. Changes in the pattern of water use may affect other holders of water rights if their rights depend on existing patterns of use (GAO, 1994). Water may no longer reach their farms or it can not be taken out by original structures. Under Colorado water law a transfer may not cause injury to other parties (no damage principle) and other senior water right holders (irrigations) can legally prevent transfer in the event of injury. To simplify the implementation and enforcement of the no injury rule the consumptive use rule was created to protect off stream water users. Under this rule only the consumptive use of water can be transferred. Although information on consumptive use is more difficult to obtain than on actual use it solves the problem of avoiding injury on other consumptive users (for instance farmers). The difficulty in measuring consumptive use and return flow significantly increases the transaction cost of this system (Young, 1998b). However, if consumptive use rights are transferred other consumptive users are not harmed and even costlier litigation is avoided (Young, 1998b). Therefore in most states in the Western USA, water rights are based on consumptive use (water consumed by plant), with protection of third party rights to return flows. Transferring consumptive use rights may entail setting river basin and regional standards for the consumptive use of water per irrigated acre based on crop type, historic water availability, and other local variables. Such standards should be flexible enough to account for variations in water availability and local conditions. These data should be developed by the buyer and seller and third parties should not have to develop the data.

3.3 Other non consumptive right holders (instream and environmental uses and users)

The consumptive-use rule was not designed to protect non consumptive uses such as instream uses from injury during the transfer process. The most significant externalities are associated with recreational and environmental water values and with water quality. Benefits generated by instream flows are often public goods not conducive to well defined property rights and characterized by

non-rivalry and non-excludability.

If a water right is transferred from down stream to up stream, then stream flow will be less below the new diversion (up stream) point if the buyer is a farmer or other consumptive (i.e. urban) user. Reductions in instream flows may impact negatively on the environment or aquatic wildlife (GAO, 1994). If transfers are conditioned by the 'no damage' principle, instream rights are secure but flexibility in transfers is sacrificed. The flexibility by being able to transfer a water right adds value to it because the market value of a right reflects not only the value of current use but also that of future opportunities.

The impact of transfers on instream flows that are not protected by water rights may or may not be considered during a transfer hearing in the Western USA, depending on the state. Whether this will change in future is unknown.

3.4 Water quality

Most water diverters are not required to take into account the deterioration in water quality they impose on the stream. It is estimated that the Grand Valley Irrigation Project in Western Colorado was contributing 10 tons of salt to the Colorado River per irrigated acre per year (Howe, 1998).

In Colorado, the extension service is charged with the adoption of voluntary Best Management Practices (BMP) by educating farmers on the level and timing of nitrogen in order to meet but not exceed crop uptake. At present penalties are uncertain and Livingston and Cory (1998) conclude that state initiated monitoring with meaningful fines are required. Enforcement effort should further be targeted on soils susceptible to leaching.

In the Eastern Cape in South Africa the return flow of irrigation water is so highly polluted in the Fish and Sunday's rivers that the return flow is not suitable for irrigation. The writer visited this area in 1998 and 2000. The Department of Water Affairs regularly flushes these rivers by releasing water from the Orange River. The water from the Sunday's River is not fit for human consumption in Port Elizabeth due to high pollution levels according to the city's water engineering department and treatment costs are high.

How to provide incentives to farmers to reduce pollution is problematic. A pollution tax ("Pigovian") on water applied in these resource sensitive areas may be considered. In the above situation the tax may be based on additional cost of water used to flush the system plus the treatment cost of the Port Elizabeth municipality down stream. To simplify monitoring and enforcement it is further

suggested that the tax be based on (actual) area under irrigation.

3.5 Equity

Considering equity is an essential feature of a water market. In developing countries, equity is usually studied in terms of the distribution of benefits to small and larger farmers (Sampath, 1992). In the Western USA equity is often seen in terms of the equitable apportionment of interstate waters between states (Howe, 1996) while the USA Congress freed Native American tribes from obligations to repay any of the capital costs of constructing federal irrigation projects (Young, 1998a).

It is essential that South Africa addresses the equity issue as it would provide more stability to the social fabric of society and the new Water Act is evidence that the government is serious in its commitment. Constitutional changes are aimed at empowering previously disadvantaged communities and it is certain that in all future projects welfare implications will be considered. These communities need protection in a water market as water may move from impoverished areas to farmers more able to buy it.

Howe (1996) and Sampath (1992) conclude that both equity and efficiency may be promoted in a water market. It is however, questionable, whether small-scale farmers in South Africa will gain more water through market forces because of capital and technological constraints. Although these communities may not be able to compete with commercial agriculture in a market for water, leasing of water within the community may promote higher value use.

The value of water is incorporated in the price of land and more equitable access to water will be provided in South Africa through the redistribution of land programme.

3.6 Opportunity cost pricing

A main problem with opportunity cost pricing is that the supply and demand of water are seasonal and variable and opportunity costs vary accordingly and can not be estimated. A further problem is that water needs to be metered. Opportunity costs are also subjective and can not be objectively observed.

The market solution to price water at opportunity costs is tradable water rights. A discussion follows of lessons from the market institutions for tradable water rights in the Western USA and particularly as it relates to the Northern Colorado Water Conservancy District (NCWCD).

4. LESSONS FOR SOUTH AFRICAN WATER MARKETS

Water markets may encounter ideological opposition as water traditionally has been regarded as a public good. The Colorado example shows that a market can develop for the usufructuary rights of water while water itself remains public property. The highly transferable Colorado-Big Thomson water is owned by the US Government. This is important for South Africa as according to the new Water Act, the South African Government will act as the custodian of the nation's water resources and its powers in this regard will be exercised as a public trust. The Colorado example also shows that a water market implies both government involvement and active water user participation. The government can assist in institutional support but water needs to be managed at the lowest appropriate level.

Farmers in South Africa pay water rates on listed area whether or not water is used. This policy has merit and should be continued as it allows the state to recover some of its expenditure. Also under riparian ownership in South Africa, farmers have the incentive to claim water rights on land that is not under irrigation and which may not really be suitable for production, and payment of water rates will reduce the incentive to do so. According to the new Water Act the non use of water (sleeper rights) may not be seen as beneficial use and SA farmers may lose these water rights. This may be seen as confiscation especially as farmers have paid water rates in the past. The problem of sleeper rights also exists in Australian water markets (McKay, 1999). According to McKay (1999), the various state governments in Australia have not had the will to take sleeper rights away and rights are tradable.

The policy in SA of paying water rates on listed area does not attach a scarcity value to water as water is not volumetric priced. Irrigation water is thus under priced in South Africa. Administrative pricing of water at opportunity costs will not be successful as opportunity cost varies during the season based on water availability and therefore can not be calculated. In a water market water is not priced by administrators but the market attaches an opportunity cost price to water and promotes the highest valued use of the water. This has equity implications for the broader population as they benefit if agriculture uses water more economic efficiently, and releases water. In spite of the absence of legal institutional support, water markets have started to emerge in the Lower Orange River and in the Fish and Sunday's rivers in the Eastern Cape. Current ownership uncertainty of water in South Africa is not conducive to transfers and trading along these rivers stopped (Armitage & Nieuwoudt, 1999).

There are two reasons why agricultural water markets do not release water in

South Africa. The first reason is that the only water trades that have taken place in these rivers are between non-users of water (sleeper rights) and intensive users (Armitage & Nieuwoudt, 1999). The equity objective of releasing water for urban use is at present not being promoted in South Africa and it may take time before all sleeper rights are activated.

The second reason is that transferring diverted use of water in agriculture does not attach a price (opportunity cost) to the use of water (consumptive use). Agricultural water is thus not released for urban use in spite of the higher opportunity cost price. The transfer of diverted use (water actually applied) provide irrigators the incentive to irrigate larger areas by adopting technologies that reduce application rates. The result is that the consumptive use of water increases and water prices thus do not promote water conservation. This is the case in South Africa that diverted use is transferred and that irrigation farmers are permitted to irrigate larger areas if they adopt water conservation technologies such as drip irrigation. Administrative volumetric pricing of diverted use of water will also not promote water savings in agriculture for the same reason.

In the Western USA water is transferred based on consumptive use to protect other consumptive users who may be harmed by diminished return flow if water is diverted from a fully appropriated stream. An exception is Colorado-Big Thomson water where transfers are on diverted use. The reason is that this water is imported into the region (new water) and no third party claims exist on this water. Non consumptive uses such as instream uses, however, need to be protected from injury during the transfer process. The most significant externalities are associated with recreational and environmental water values and with water quality. Environmental issues have become more prominent in the Western USA and a trade off exists between security of environmental rights and flexibility of water transfers as protection of instream rights will constrain transfers.

Although water trades from down to up stream may reduce instream flow and harm the environment the more usual trades are in the opposite direction which will benefit the environment. Institutions need to be created in South Africa facilitating trades while providing protection to the environment. The new South African Water Act gives prominence to third party (environment and human needs) issues and in this context third parties are more protected under South African law than in the USA.

Water engineers have played a major role in water markets in the USA and in South Africa. Their role is important as third party issues are often of a technical

nature. The findings of the State Engineer are usually accepted by all parties in Western States while water courts have delayed the process and made it expensive. Poor communities may also not find it financially feasible to contest claims in court.

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