Evaluation of the Texas Water Bank

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June 2001
Introduction

The state of Texas is increasingly faced with shortfalls in the supply of, and escalating demand for, water. Markets provide a mechanism to allocate resources to their highest valued use. But what happens when markets do not form on their own for any number of reasons?

In order to help alleviate some of the pressure, the 73rd legislature of the State of Texas passed SB 1030 which provided for the creation of a statewide water bank. This Texas Act follows on the heels of the actions taken by the State of California in 1991 with the creation of the California Drought Water Bank. In both cases the goal of the banks are to facilitate the transfer of water from seller to buyer in a well functioning market.

The Texas Water Bank (TWB) has been open for business since May 1994 and very little use has been made of it to date. The focus of this chapter is to reveal the possible reasons for the lack of use of the Texas Water Bank, especially in light of the drought conditions that the state has faced over the past several years. In addition, steps to improve the policies and operation of the water bank will be presented and evaluated.

To better understand the role that the Texas Water Bank is attempting to play, a standard with which to compare it must be presented. Since the original intent of the TWB was to trade water in a market-like environment, comparisons and contrasts with commodity markets will be helpful in the critical evaluation. In addition, the experience of the California Drought Water Bank will provide a means of comparing and contrasting the Texas Water Bank with a pre-existing water marketing and allocation mechanism. Commodity markets that are extensive will have many buyers and sellers along with ease of information with regards to price.
Commodity Markets

Since the goal of the Texas Water Bank (TWB) is to create a market for water, a better understanding of how commodity markets operate is necessary. Two commodities will be examined. The first, livestock and meat, is a well established and very active market. The second, emission allowances, is a young environmental market.

In commodity markets around the world, numerous goods are exchanged on a daily basis. In these markets a buyer and seller agree on a price and contract to exchange goods of specified quality and quantity for delivery in the immediate future. However spot markets are volatile and traders and merchants are exposed to large risks because the value of their inventories can fluctuate. In order to gain some protection from sudden changes in prices, buyers and sellers developed forward markets in which contracts are exchanged for the delivery of a certain quantity at a predetermined price, at some agreed time in the future [Atkin, 1989]. In forward exchange markets, contracts are ordinarily satisfied by actual delivery of specified items on a specified date. In the futures market, almost all contracts are "offset" prior to delivery [Kidwell and Peterson, 1987].

There exist problems with spot and forward markets. The disadvantages stem from the fact that each forward contract is specific to the two contracting parties. The price reflects quantity, quality, delivery date, and delivery location. These other factors limit the value of the contract to anyone other than the two contracting parties, making it difficult to establish a secondary market in forward contracts [Atkin, 1989].

Futures markets differ from forward markets, in that they are legal agreements between two parties to deliver a commodity at a future date. The quantity, quality, delivery date, and delivery point are all standardized leaving only the price to be established by the contracting parties. They are therefore pure price markets [Atkin, 1989].

In the forward and futures market there are two major participants, hedgers and speculators. Hedgers try to reduce price risk inherent in their balance sheets or future business dealings by guaranteeing buying and selling prices for closely related contracts. Speculators, on the other hand, take risks in the futures markets. They are willing to enter a futures transaction in hopes that the market price will move in a favorable direction [Kidwell and Peterson, 1987].

Livestock and Meat

One of the more important roles that spot and futures markets play is providing a public source of prices for important commodities. More importantly is that a futures price is a 'pure price', in that all the details of delivery, quality, quantity are standardized. In addition, what is essential to the role of the market is liquidity. In order to establish fair prices, it is necessary that there is a large number of buyers and sellers in a market [Atkin, 1989]. Successful markets requires both the support of the trade and the interest of the speculative community.
A contract on pork bellies by the Chicago Mercantile Exchange (CME) in 1962 began the trading of livestock and meat products. One of the factors that inhibited the earlier development of meat complex futures was the difficulty in devising a contract. Meat products were not easily defined as a commodity because of the heterogeneity of the animals. However after World War II the intensification of agriculture led to advances in breeding and feeding practices and therefore the uniformity of the age and weight of the animals at slaughter. It then became possible to view the animals and meat products as relatively homogenous commodities.

One of the limitations in the livestock market is that it cannot be stored like grain. However, the meat can be frozen but fresh meat provides a price premium over frozen. In addition, contracts on meat, rather than on animals, do not provide hedging opportunities for farmers. The absence of stocks which can be built up or drawn down in response to price movements and the limited ability of farmers to adjust the timing of supply of animals to market mean that cash prices are volatile [Atkin, 1989].

The Chicago Mercantile Exchange has contracts on live hogs and pork bellies. Cyclical patterns dominate the pork markets and for some time there has been a movement away from pork and meat products in general. Demand pressures, however, are less important in the pork belly market, which can be analyzed in the traditional supply oriented way. This is due to the fact that the demand for bacon, which bellies are used to produce, is highly price inelastic. Individuals who consume bacon with their breakfast appear not to be very sensitive to changes in the price of bacon.

Livestock and meat markets provide a mechanism in which the commodity can move easily amongst buyers and sellers. The obvious advantage of the market is the reduction in transaction costs. Potential buyers and sellers do not have to search each other out on an individual basis but can turn to the market for that information. In addition, since contracts are standardized negotiations over the quantity, quality and date of delivery are unnecessary. The absence of a well functioning market would mean that individuals would have to conduct the search for information and negotiations on their own, thereby increasing costs.

Pollution Markets

Title IV of the Clean Air Act Amendments of 1990 (CAA) has introduced the market based approach for controlling sulfur dioxide emissions instead of relying on the command and control (CAC) approach. This market based approach involves the trading of emission allowances, which is expected to provide flexibility, efficiency, conservation and innovation in achieving the environmental goal of reduced emissions [Samayoa, 1993].

Marketable emission allowances start with a goal for total allowable emissions for a particular region. Incentives are then put in place to achieve the overall environmental goal in the least costly manner. Marketable emission allowances let firms that can control their emissions at very low costs to have the incentive to do so. Those firms with higher costs for pollution control have the option to purchase allowances from the low cost firms.
For a market to exist, there must be a proper composition of active participants to support it. This requires a large pool of traders, varied enough in their need for emission allowances to ensure that many will buy and sell. There must also exist the willingness of the participants to use the market system. The willingness to use the system will be influenced by two factors. First, there must be an incentive to trade the emission allowances. Second, transaction costs must be sufficiently low to maintain the incentive to trade [Hahn and Hester, 1989]. The benefits from trade must be greater than the costs involved. Costs of trading include both the price of the emission allowance, which reflects the risk of future unavailability, and the transaction costs [Samayoa, 1993].

The lower the transactions costs, the greater the gains from trading. An auction system helps facilitate the process for buyers and sellers to identify each other, thus reducing costs. The simplicity of the trading process also helps reduce costs and encourage trading.

On April 21, 1992 the Commodity Futures Trading Commission (CFTC) voted to designate the Chicago Board of Trade (CBOT) as the contract market for emission allowances. The CBOT can establish a market for futures contracts and options in futures contracts in the allowances. Each emission allowance futures contract traded on the CBOT will be equal to 25 tons of sulfur dioxide emission [Samayoa, 1993].

Futures prices generally reflect all of the currently available market information concerning the anticipated value of the product at a particular point in the future. Given that all available information is reflected in the price, efficiency will be a result of the use of a commodity market. The price on pollution contracts will lead to informed and, therefore, more efficient decisions.

However, involvement by individual entities in a pollution allowances market also involves risk. Futures contracts are used to hedge against price fluctuations several months or years ahead of when the transaction will even occur, thus reducing the risk. Using the futures market to protect against changes in price is known as hedging [Samayoa, 1993]. The use of the futures market also reduces some legal risks. Cash market contracts entered outside the CBOT futures market carry the risk that the counterparty will breach its contract because of bankruptcy or other causes. One of the functions of the futures and spot market is to reduce the risk. If a counterparty fails to perform on a futures contract the CBOT would make payment or enter into the spot market to obtain allowances.

The availability of emission allowances is crucial to ensure both the economic efficiency of the emissions limitation program and the addition of new electric generating capacity. Therefore, Title IV of the CAAA mandates that EPA hold or sponsor yearly auctions and direct sales of allowances for a small portion of the total allowances allocated each year. In addition, Title IV requires that EPA provide a written guarantee ensuring priority for certain new independent power producers (IPPs) in purchasing allowances in the direct sales. The auctions, sales, and IPP guarantee provisions of Title IV help ensure that units have a public source of allowances beyond those allocated initially to existing units. Moreover, auctions are expected to help signal price information to the allowance market early in the regulatory program [CBOTA, 1996].
An efficient cash market is essential to ensure that program participants can readily buy and sell allowances as needed. Utilities need to be able to cheaply and easily obtain allowances to cover unexpected increases in emissions and to sell any excess allowances. The CBOT plans to provide a forum for cash market trading of emission allowances through its electronic trading system Project A. The Project A system will provide:

- A low cost, flexible trading system.
- Trades that are guaranteed by the Board of Trade Clearing Corporation.
- Easy access and wide dissemination of bid, offer, and other trade information.
- An efficient pay and collect system.
- Full audit services.
- A reliable transfer and tracking system. [CBOTb, 1996 p. 2]

The auction, cash and futures market created by the CBOT for pollution allowances provides a competitive atmosphere. However Tietenberg [1988] notes that with a fixed supply of allowances the potential for imperfect competition develops. In the competitive market (auction) prices for the allowances will be higher than in a noncompetitive environment. If imperfect competition develops then the price-setting firm will control more allowances than if it was a price taker and the price-taking firm would control fewer allowances in the competitive rather than the noncompetitive market. In addition, the noncompetitive auction market allocation of control responsibility is not cost effective with control costs higher in noncompetitive markets.

Another facet of the emissions trading program is the banking of permits. The banking component establishes procedures that allow firms to store emission allowances for subsequent use. Problems can arise because the property rights to the emission reductions, which are to be banked, are not always vested in the supplier. There is a feeling among some communities that the deposits be appropriated by the community at large to be used for public purposes. In San Francisco, for example, deposits made by corporations in the emissions reduction bank could subsequently be confiscated if the control authority found need to impose more stringent standards [Tietenberg, 1988]. Treating the banked permits as community, rather than private, will result in less flexibility and higher control costs.

**Water Banking**

With increased recognition of surface and groundwater scarcity in portions of the Southwestern United States and in many other parts of the world, there has been many initiatives to try and improve the efficiency of water in many uses. A number of these initiatives have involved water markets, transfer or trading among similar or different user types. The importance of markets and transfers is they offer a vehicle by which low valued use and ownership rights may temporarily or permanently transferred to high valued uses.
Water banking is one mechanism that is available to transfer water among varying uses. The term "bank" in some cases may be a misnomer. However, we can examine the role that a commercial bank plays as an analogy. In the very broadest sense, a commercial bank can be described as a "financial intermediary." They acquire deposits in many forms and are then able to lend a fraction of those deposits to individual entities. The role played by the commercial bank is bringing two sides of the financial market together, those who have funds to loan out and those who wish to borrow, in the most efficient manner possible. Financial intermediaries can achieve economies of scale because of their specialization. Because they handle a large number of transactions, they are able to spread out their fixed costs. In addition, they can reduce the transactions costs involved in searching for credit information [Kidwell and Peterson, 1987].

The commercial bank creates a market for financial assets to flow from low valued use to higher valued uses. In this section, we will look at two "water banks" and the role that they attempt to play in water markets.

**California Drought Water Bank**

The California Drought Water Bank (CDWB) was established in 1991 with an Executive Order of the Governor. The Bank was created during an emerging water crisis in the state after several years of drought conditions. Statewide reservoir storage was 32 percent of capacity and precipitation averaged 28 percent of normal [Howitt et al., 1992]. The State Water Project and the Central Valley Project which respectively account for 7.4 percent and 21.7 percent of California’s reliable water supplies, had announced sharp cutbacks in water deliveries.

The Water Resources Control Board of California held meetings to determine what orders should be issued. Some of the actions considered other than the Water Bank were:

1. Order operators of large reservoirs to enter into short-term contracts to provide water to municipalities;
2. Order municipal suppliers to institute mandatory water rationing or conservation programs to hold average household water use at 300 gallons per day;
3. Give perennial crops first priority for irrigation with surface water, but only at levels for plant survival;
4. Restrict reservoir operations for fishery protection to rare and endangered species;
5. Reduce or temporarily cease releases of stored water for instream beneficial uses if such changes do not create irreparable damage to instream beneficial uses. [Howitt et al., 1992 p. 4]
In the end, the Governor decided on four specific points in establishing the drought action plan. Including the Water Bank; communities should adopt rationing plans that implement 50 percent cutbacks in water use; directed the California Department of Fish and Game to work with the U.S. Fish and Wildlife Service to protect habitats and prepare for the restoration of natural areas when the drought was over; and the governor would sponsor legislation to establish a Drought Action Fund to provide technical and financial assistance to communities.

Membership in the Water Bank was extended to any corporation, mutual water company, or public agency that had responsibility to supply water for agricultural, municipal and industrial, fish and wildlife or other uses in California in 1991. Bank water would be conveyed through the State Water Project facilities. Water was made available to those entities with "Extreme Critical Needs" first and then remaining supplies to those with critical needs.

The contracts that Bank members agreed to required the Department of Water Resources to diligently seek water from willing sellers at prices members were willing-to-pay as determined by the Water Purchase Committee. Funds were deposited into the Bank to make purchases of water. A requirement was that the bank must sell water at a single "melded rate" that reflects all costs incurred to acquire water (acquisition, legal, administrative, financing, and the impact of carriage water and other losses) [Howitt et al., 1992]. The rate was $175/af. A member's failure to accept delivery did not relieve the member from the obligation to make payments for water necessary to meet its critical needs.

The bank acquired water from sellers at a price of $125/af. The contracts included a "price escalator clause," which guaranteed that a seller would receive the same price as other similarly-situated sellers if the average price exceeded the contract price by 10 percent. The CDWB acquired water in three ways; fallowing contracts, groundwater, and stored water.

With fallowing contracts the bank paid growers for the net amount of water saved as a result of not using surface water for the 1991 irrigation season. To be eligible, land must have been farmed in 1990, or had been used as a set aside under the federal Farm Commodity program, and planned for agricultural production in 1991.

Groundwater contracts provided "new water" to the bank primarily through substitution of groundwater for surface water. The majority of the groundwater contracts provided that landowners pump groundwater for irrigation, meter the amount of pumping, and in exchange the water district would release an equal amount of its surface supply to the bank. To ensure that pumping did not adversely affect local groundwater basins, monitoring programs were established. Stored water involved the transfer of water from reservoirs to the Water Bank. The most significant acquisition involved 157,200 acre feet from the New Bullards Bar Reservoir.

Since this was a first attempt at formalizing a water market in the state of California, a number of follow up studies were conducted to gather information on the function of the Bank, perceptions, and improvements for future efforts. Farmers, business people, civic leaders, and third parties were sampled. The studies were conducted by private firms, state agencies and universities.
Of significance is the regional impact that the Water Bank had beyond those directly involved. Overall, the amount of land fallowed for the bank was about 10 percent of the field and vegetable acreage for major counties. The Bank generated direct benefits for the State economy by creating a net gain in income and employment by trading water from lower value to higher value uses. Table 4.1 [Howitt, 1994] shows the net financial benefits of the water trades through the CDWB. The financial effect on exporting regions was calculated from the net effect of decreases in revenues associated with crop production, but included increases in the net income of the farmers who sold water to the bank. The increased farmer profits did not fully offset the loss of crop production expenditures on the local economy. The farmers would not have sold their water below its value marginal product, but the regional income loss is caused by the difference in multipliers and expenditure patterns between crop expenditures and increases in net farmer income due to water sales. The urban benefits were harder to estimate. Some analysts cited values of marginal urban water use of $988 - $1235/af of water that are often imputed from intensive manufacturing uses. The net benefit to all importing regions is estimated at $104 million which is a lower bound on the benefits. The sale of water between regions also had a positive net effect on employment. Jobs were lost in water exporting regions, but the gains in the importing regions far outweighed the losses.

The general consensus was that the Bank was successful, particularly given the emergency circumstances under which it was created. Most believe, and some were concerned that the bank has just scratched the potential for water banking and trading in California. It worked well enough that some think it should be pursued further [Howitt et. al., 1992].

In a study conducted by Dixon, Moore and Schechter [1993], 29 percent of the farmers and 11 percent of the businesses responded as having some positive perceptions about the Bank. They indicated that the income sellers received, as a result of the Bank, helped farmers and landlords pay off debt and become financially stable along with making small farm investments.

Table 1. Net Benefits of the CDWB. (millions of dollars)

<table>
<thead>
<tr>
<th>Exporting regions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Income lost from crops</td>
<td>$76.02</td>
</tr>
<tr>
<td>Income gain from water sales</td>
<td>63.27</td>
</tr>
<tr>
<td>Export region income</td>
<td>-12.75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Importing regions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Income gain in agriculture</td>
<td>$45.40</td>
</tr>
<tr>
<td>Urban consumer surplus gain</td>
<td>58.77</td>
</tr>
<tr>
<td>Benefits to importing regions</td>
<td>104.17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Net benefits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture benefits</td>
<td>$32.65</td>
</tr>
<tr>
<td>Statewide income benefits</td>
<td>91.42</td>
</tr>
<tr>
<td>Value of surplus water</td>
<td>14.40</td>
</tr>
<tr>
<td>Total net benefit</td>
<td>105.82</td>
</tr>
</tbody>
</table>

Adapted from Howitt [1994].
Some of the negative feelings of the Bank was that it hurt local businesses. The support services of the agricultural industry were specifically mentioned as being negatively impacted. In addition, the Bank was thought to have a negative impact on the community as a whole. Farmers became jealous of each other because they felt that the other one was getting a better deal from the Bank. Farmers were upset with the water districts or landlords, who received the income, for selling water they normally use and not being compensated for it. Also, tenant farmers complained that some of their landlords did not want to share any Bank money with them and some did not even know that their water had been sold.

Allowing water users to sell water to a market, in this case the CDWB, acknowledges the implicit property right that water users have established and capitalized into their land values. Water is a resource whose ultimate ownership is vested with the State of California and the dominant political and legal view is that the exercise of individual property rights in water should be constrained by the consideration of the greater good in the region [Howitt, 1994]. However, the perception and realization of third-party impacts is present with the Bank.

Third-parties impacted are those businesses and individuals mentioned above where employment and income can vary depending on whether you are in an exporting or importing region. There are other third-parties that can be affected including neighboring farms, wildlife and the environment.

Part of the Banking program involved selling surface water and using groundwater as a substitute. Groundwater overdrafting, increased pumping costs to non-bank participants, and subsidence are of concern to local communities. They understand the value of their groundwater resources and want to protect them. Many groundwater basins in water selling regions have not been heavily utilized and the hydrology and interconnections between basins and surface water supplies are not well understood. In Butte County, a water selling region, there has been a movement to establish a water protection association for the same reasons mentioned above [Mikles, 1996]. Overdrafts from large wells caused a regional drop in the water table of between 10 and 20 feet which left some individuals dry. There is an interference ordinance in effect but it does not affect existing wells and does not keep large pumping projects from occurring again.

Representatives from fish and wildlife groups were also concerned that there was no mechanism to allocate water for fish and wildlife. In addition, they felt that revenue from any water banking go to the farmers and not water agencies. The reason for this is that the representatives fear that funds going to water agencies could lead to an expansion of facilities and subsequent environmental damage. There was concern that rights to return flows are uncertain and may be substantially diminished by water banking. Many waterfowl habitat depend on return flows to provide all or part of their water supply [Howitt et. al, 1992].

As a result of experiences and perceptions of the 1991 CDWB, suggestions have been made on how to improve future banks [Dixon, Moore and Schechter, 1993 p. xi]:
• **Spread purchases to diffuse negative economic impacts.** Negative impacts of the Bank varied substantially by county. To reduce negative impacts in any one area, DWR should spread purchases out as widely as possible.

• **Rotate farmers in future banks.** Increases in farm investment partially offset the drop in operating costs caused by the Bank, but there is likely a limit to the amount of investment that a farmer will make on their farm. This suggests that the DWR should limit how often or how much water a farmer could sell to future banks.

• **Do not assume that groundwater-exchange contracts have no adverse economic impact.** Their findings suggest that these contracts caused farm production to fall.

• **Consider lowering the purchase price of water.** Their findings suggest that DWR could have found many willing sellers at less than $125 per acre foot.

• **Start future banks as early as possible, and use standard rules and contracts.** An earlier start date might allow DWR to pay less for water, because some farmers will not have incurred preplating and planting costs. DWR could publish, prior to negotiations, a list of rules governing enrollment and standardized contracts to reduce transaction costs.

• **Develop procedures to ensure that both landlords and tenants are included.** This would ensure that the water sales did not come as a surprise to either party and would help reduce divisiveness caused by the bank.

### Texas Water Bank

In Texas, water marketing has recently become an issue of importance due to increasing urban growth, limited supplies of available water, and an increasing awareness of the environmental necessity of water to maintain viable ecosystems. The Texas Water Bank (TWB) was created to assist in water marketing transactions, providing a forum where willing buyers and sellers can meet [TWDB, 1996].

The 73rd Legislature (1993) passed, and Governor Ann Richards signed, SB 1030 which provided for the creation of a statewide water bank. The Act has been codified as V.T.C.A., Water Code 15.701-15.708, new Subchapter K. The Act authorizes the Texas Water Development Board to both establish and administer a water bank to facilitate the transfer of water and water rights among willing buyers and sellers throughout the State.

At the same time that the TWB was being created, there was great concern over the future of the Edwards Aquifer. The Edwards is the only source of water for the City of San Antonio as well as other municipalities and numerous agricultural interests. In addition, the Comal and San Marcos springs are directly affected by the activity that takes place in the Edwards and it had been determined that endangered species occupied these springs.
The continuing problems with the Edwards and drought situations in other parts of the state there was concern amongst the legislature about meeting the future needs of the state. The first year of operation of the CDWB had been fairly successful and sounded good to certain members of the Texas State Legislature, according to the TWB manager. This provided the impetus to create a water bank in Texas [TWDB, 1997].

SB 1030 is very broad in the manner that it instructs the TWDB to create and operate the TWB. The key aspects of this bill are as follows [State of Texas, SB 1030, 1993, p 2]:

\[sec. 15.703\]
The board may take all actions necessary to operate the water bank and facilitate the transfer of water including:

(1) negotiating a sale price and terms acceptable to the depositor and purchaser;
(2) maintaining a registry of water bank deposits and those water users in need of additional supplies;
(3) informing water users in need of additional supply of water rights available in the bank;
(4) encourage water right holders to implement water conservation practices;
(6) purchasing, holding, and selling water rights in its own name;
(7) establish regional water banks.

\[sec. 15.704\]
Up to 50 percent of a water right may be deposited in the water bank for an initial term of up to 10 years, during which time the water right is exempt from cancellation by the commission. A water right is exempt from cancellation only once even if it has been transferred or redeposited.

The commission may not bring a cancellation action of the code for a 10-year period following commission approval of any necessary actions relating to a water right which has been transferred while on deposit in the water bank.

\[sec. 15.705\]
The board may charge a transaction fee per transfer not to exceed $500 to cover expenses of the board in operating the water bank.

\[sec. 15.708\]
Nothing shall prevent the sale or purchase of water or water rights by or through persons or entities outside of the water bank or the creation or operation of water banks by other persons to the extent allowed by law.

Once the bill had been signed, the development for the operational rules for the TWB began. This process involved meeting with civic leaders and river authority managers. Statewide information
gathering meetings were conducted in McAllen, Victoria, and Lubbock. Drafts of the water bank rules were distributed in March of 1994. Then a public hearing was conducted for the proposed rules with one written and one oral comment were received. The bank became fully operational on May 13, 1994.

Some of the concerns and suggestions that were raised at the meetings helped shape the current TWB Rules. For instance, a general concern was expressed that someone could adversely affect their neighbors by depositing acreage or groundwater rights in the bank, where a buyer could then create a cone of depression. Also, would there be separate rules for groundwater?

The idea of regional banks was a popular topic at the informational meetings. It was suggested that the TWDB establish a locally controlled water bank for the Rio Grande Valley. The local board that oversaw the regional bank would establish a reasonable price for water sales but use of the price would not be mandatory. Concerns were then raised as to how the TNRCC Watermaster, which is functioning like a bank, would interact with the TWB.

The significant sections as they apply to this analysis, of TAC Chapter 359 (Water Bank Rules), that also have not been discussed with regards to SB 1030, are presented below [Water Bank Rules, 1993, p. 2]:

**Sec. 359.3**  
The board may purchase, lease, hold, accept as a gift, and sell water rights or the right to use water as necessary to operate the bank and facilitate the transfer of water rights from the bank for future beneficial use in Texas.

**Sec. 359.5**  
A potential depositor shall file a completed application for deposit with the administrator. The administrator shall notify the potential depositor and executive director of the commission within 30 calendar days of submission of a completed application of the acceptance or refusal of the deposit.

**Sec. 359.6**  
The administrator may withdraw a deposit where the administrator finds the deposit to be:
(a) representative of a water right, or portion thereof, that is not quantifiable;
(b) representative of a water right, or portion thereof, where a petition or other formal action has been filed with the commission for the cancellation or forfeiture of the water right before the date of deposit.

**Sec. 359.7**  
Decision of the administrator may be appealed to the board by filing notice with the administrator.
Sec. 359.8

(e) That portion of a water right that has been deposited in the bank may be withdrawn upon the depositor's completion of a withdrawal form and its submission to the administrator.

(f) A water right may be used as authorized by law while on deposit in the bank.

(g) A water right transferred while on deposit in the bank may remain in the bank.

The TWB is currently fully operational. There is 1 deposit, 14 registered sellers, and 2 registered buyers as of June 15, 2001 (see Table 2). The only difference between a depositor and a registered seller is that the depositor's water right is protected for an initial 10 years from cancellation. All deposits and

Table 2. Registered Buyers and Sellers.

<table>
<thead>
<tr>
<th>Buyer/Seller</th>
<th>Basin</th>
<th>Quantity</th>
<th>Location</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deposit</td>
<td>Colorado</td>
<td>27.93 acre feet</td>
<td>Near Menard</td>
<td>Lease</td>
</tr>
<tr>
<td>Buyer #1</td>
<td>Canadian</td>
<td>Seasonal</td>
<td>City of Canyon</td>
<td>Recreational Facility</td>
</tr>
<tr>
<td>Buyer #2</td>
<td>San Antonio</td>
<td>3000 acre feet</td>
<td>Upstream of Lake Medina</td>
<td>Purchase or trade</td>
</tr>
<tr>
<td>Seller #1</td>
<td>Rio Grande (Ground Water)</td>
<td>90 mgd.</td>
<td>Val Verde County</td>
<td>Trinity-Edwards formation</td>
</tr>
<tr>
<td>Seller #2</td>
<td>Rio Grande (potable water)</td>
<td>0.3 mgd</td>
<td>Zapata County</td>
<td>Desalinized groundwater</td>
</tr>
<tr>
<td>Seller #3</td>
<td>Colorado</td>
<td>n/a</td>
<td>San Saba County</td>
<td>Lease</td>
</tr>
<tr>
<td>Seller #4</td>
<td>Colorado</td>
<td>1000 acre feet</td>
<td>San Saba County</td>
<td>Certificate of Adjudication</td>
</tr>
<tr>
<td>Seller #5</td>
<td>Guadalupe</td>
<td>1500 acre feet</td>
<td>Near Victoria</td>
<td>Long term lease</td>
</tr>
<tr>
<td>Seller #6</td>
<td>San Antonio</td>
<td>27 acre feet</td>
<td>Bandera Creek</td>
<td>Elam Creek</td>
</tr>
<tr>
<td>Seller #7</td>
<td>San Antonio</td>
<td>284 acre feet</td>
<td>Goliad County</td>
<td>Lease for irrigation</td>
</tr>
<tr>
<td>Seller #8</td>
<td>San Antonio</td>
<td>86 acre feet</td>
<td>Goliad County</td>
<td>Lease for irrigation</td>
</tr>
<tr>
<td>Seller #9</td>
<td>San Antonio</td>
<td>500 acre feet</td>
<td>Near Tivoli</td>
<td>Long term lease</td>
</tr>
<tr>
<td>Seller #10</td>
<td>Nueces</td>
<td>720 acre feet</td>
<td>Uvalde County</td>
<td>Lease</td>
</tr>
<tr>
<td>Seller #11</td>
<td>Rio Grande</td>
<td>743 acre feet</td>
<td>Presidio County</td>
<td>1925 priority date</td>
</tr>
<tr>
<td>Seller #12</td>
<td>Rio Grande</td>
<td>6 mgd (est.)</td>
<td>Val Verde County</td>
<td>Ground Water</td>
</tr>
<tr>
<td>Seller #13</td>
<td>Colorado</td>
<td>100 acre feet</td>
<td>Menard County</td>
<td>1904 priority date</td>
</tr>
<tr>
<td>Seller #14</td>
<td>Colorado</td>
<td>140 acre feet</td>
<td>San Saba County</td>
<td>1912 priority date</td>
</tr>
</tbody>
</table>
registrations are available for review at the web site of the TWDB. Also individuals may contact the Water Bank manager to obtain a list with the same information. Water prices are not provided. Determination of the price is left up to the contracting parties; however, the TWB will help in negotiations if asked.

**Critique of the Texas Water Bank**

Markets exist to move goods or services from one agent to another. In the preceding sections the structure of various markets has been presented. With regards to commodity markets, an examination of both meat and pollution allowances provided insight into what desirable characteristics exist for a formal market. Experiences with the California Drought Water Bank, both positive and negative, provide an existing water market with which to compare and contrast the Texas Water Bank.

Jonish, Lehr and Yoskowitz [1994] examined the institutional and economic characteristics of water banking as developed in California and as to how they were being developed in Texas. They identified the effectiveness of the California bank and contrasted that with those operational rules proposed for Texas. The authors found that the purposes of the banks differed. The CDWB was a temporary entity whereas the TWB is a permanent fixture. In both cases, participation is completely voluntary. However, surface water was the source of water for the CDWB and all water rights are eligible for deposit in the TWB including groundwater.

The role of the TWB in helping negotiate the terms of a trade from the market based perspective could be viewed as reducing transactions costs. Although, the authors note, some legal specialists have interpreted this rule to be a utility based perspective, that the price of the transfer shall reflect the cost of water plus allowed rate of return to the prospective sellers which would raise the costs of transfers.

This critique will expand on the work of Jonish, Lehr and Yoskowitz [1994] by including in the compared characteristics the commodity markets previously examined. In addition, suggestions will be made as to how the TWB could enhance the use of the Bank. When examining water markets, criteria must be developed for the effective allocation of water and comparing allocation mechanisms as Howe, Schurmeier and Shaw [1986] do. Their work is generally accepted as setting the theoretical foundations of water markets. First, there must be flexibility in the allocation of existing water supplies so that water can be shifted from use to use and location to location as changes in climate, demographics and economic conditions dictate. There is need for flexibility to be built into the system in the short-run and long-run. For flexibility to exist, it is not necessary that all water be subject to reallocation, only that there exists a tradable margin within each major water-using area.

Second, security of tenure for established users is a desirable characteristic. Only if the water can be assured of continued use will the user invest in and maintain water-using systems. If the user has the right to the water, then the user should feel confident that the right will continue to exist.
Third, the user is confronted with the real opportunity cost of the resource available for his/her use. A perpetual contract for the supply of water at a fixed price will not reflect the changing opportunity costs of its use over time. However allocation of a physical quota determined by a central authority so as to reflect other demands and the available water supply may implicitly confront the user with the water’s opportunity cost. A competitive market that sets a market clearing price also confronts the potential user with the true opportunity cost.

Fourth, predictability of the outcome of the process. Many persons fear water markets because they cannot anticipate how extensive the reallocation (especially from agriculture to cities) might be.

Fifth, a water allocation process should be perceived by the public as equitable or fair. Water users should not impose uncompensated costs on other parties and parties giving up water should be compensated as well as those that are injured at points of diversion or return flows.

Sixth, a socially responsible water allocation process must be capable of reflecting public values that may not be adequately considered by individual water users. For example, water quality and instream flow maintenance my generate large public good values that may be of little concern to individual water users.

The above six criteria point us in a direction of what needs to exist in a water market for it to be considered economically efficient. In its basic form, economic efficiency is reached when an allocation of a resource makes one individual better off while making another individual no worse off. A second and more practical definition that underlies benefit-cost analysis is: An allocation A is efficient relative to allocation B if and only if in the move from A to B the winners would be able to fully compensate any losers and still be ahead. This definition does not require that all losers be compensated, just that the potential exists as Howe et al. [1986] point out.

Simpson [1992] also adds to the theoretical foundations of an effective water market. He notes that well-defined water rights must exist and that the title must be on record in such a manner that there is no possibility of dispute over the ownership of the right. Secondly, in order for a user to be assured that he or she is receiving their full entitlement under his or her water right, a system of water measurement must be established and administered. Thirdly, the water market must be administered so that rights as well as the title are secure and that any transaction in those rights is sanctioned by the relevant government jurisdiction. Fourthly, the best market allocation systems function where infrastructure is in place to allow easy delivery of the commodity to the buyer. Mobility of the commodity being traded greatly affects its marketability and the ease with which the market functions.

Saliba [1987], Colby [1990], and Cummings and Nercessiantz [1992] reiterate the conditions for an effective water market but also note that in an efficient market, water will transfer from lower-valued to higher valued uses when differences in water values at the margin are large enough to make it worthwhile to undertake a market transaction. As a result, in markets where transfers do not involve substantial transactions costs, water values at the margin will be similar in agricultural, industrial and municipal markets. The opposite will exist when transaction costs are high relative to the value of water.
The above criteria for an effective water market along with the characteristics that are attributable to the commodity markets will be used to analyze the TWB. Table 4.3 presents the characteristics that are desirable in markets for goods and services. The TWB is then compared and contrasted with commodity markets and the CDWB.

In considering the Flexibility of Allocation, commodity markets exemplify this characteristic. Contracts, allow the underlying commodities to be easily moved from one party to another. All that is required of the purchasing party is to meet the market price. When drought conditions in California placed municipalities at critically low water levels, action needed to be taken. The CDWB was established to move water from where it was to where it was needed. The system that was in place before the creation of the CDWB did not achieve this. The Central Valley Project and State Water Project has helped in the reallocation by moving water from Northern California to Central and Southern California.

Table 3. Market Characteristics.

<table>
<thead>
<tr>
<th>Market Characteristics</th>
<th>Commodity Markets</th>
<th>CDWB</th>
<th>TWB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility of Allocation</td>
<td>Yes. Contracts are easily bought and sold.</td>
<td>Yes. Water is purchased and moved to higher valued uses.</td>
<td>Yes. Water is purchased and moved to higher valued uses.</td>
</tr>
<tr>
<td>Security of Tenure</td>
<td>Yes. Contracts are a well defined property right.</td>
<td>Yes. Water is a recognized property right.</td>
<td>Yes. Water is a recognized property right.</td>
</tr>
<tr>
<td>Opportunity Cost</td>
<td>Yes. Market clearing price.</td>
<td>No. Price was not market clearing.</td>
<td>Yes. Market based pricing.</td>
</tr>
<tr>
<td>Predictability of Market Process</td>
<td>Yes.</td>
<td>No.</td>
<td>Undetermined</td>
</tr>
<tr>
<td>Fairness of Process</td>
<td>Yes</td>
<td>No.</td>
<td>Undetermined</td>
</tr>
<tr>
<td>Pricing</td>
<td>Market</td>
<td>Regulated</td>
<td>Market</td>
</tr>
<tr>
<td>Nonrestricted Participation</td>
<td>Yes. Open market process.</td>
<td>No. Only open to water right holders and municipalities</td>
<td>Yes. Any agent is able to purchase water through the bank.</td>
</tr>
<tr>
<td>Third Party Effects</td>
<td>Possible</td>
<td>Yes. Income, employment and groundwater table.</td>
<td>Yes.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Yes. Contracts are standardized.</td>
<td>Yes/No. Surface water rights are quantifiable, groundwater is difficult.</td>
<td>Yes/No. Surface water rights are quantifiable, groundwater is difficult.</td>
</tr>
</tbody>
</table>
The TWB also allows water to be purchased and moved from one party to another. The TWB was created at a time when state legislators were concerned with limited water supplies and especially the continuing problems facing the Edwards Aquifer. The process to reallocate water in the TWB is straightforward. Deposits or a registration of water for sale is made. When the water is bought, transfer of the right, either temporarily or permanently, is channeled through the appropriate authorities. River authorities would be responsible for monitoring the temporary transfer of water whereas a permanent sale would be processed through the Texas Natural Resource and Conservation Commission to amend the water right. The TWB’s greatest potential lies with the Trans Texas Water Project where water is transferred between basins.

Security of Tenure. Commodity market contracts allow trading of commodities and involve well-defined property rights. The delivery date, quality and quantity are all standardized. If by chance a counterparty failed to perform on a contract the CBOT, in the case of emission allowances, would make payment to the injured party or enter the market to replace the contract. This assurance is what makes the contract a property right.

With regard to the CDWB, water is a recognized and transferable right whose ultimate ownership is vested with the State of California. However, the political and legal view is that the exercise of individual property rights in water should be constrained by the consideration of the greater good in the region. Therefore the right could be subjected to the current social feelings of the region or state. If thought of in that regard, the property right may have less security of tenure.

In the State of Texas, a right to water is considered fully transferrable and all the benefits and costs shall accrue to the owner of the water right. Surface water rights are quantifiable but groundwater is regulated by the rule of capture. An owner of a groundwater right may withdraw as much as he/she can put to beneficial use. Therefore the water right is easily quantifiable only after withdrawal. An important characteristic of property rights is the monitoring and enforcement. Around the State of Texas there exists a problem in enforcing water rights except, along the Rio Grande [TWDB, 1997]. Water rights that are not enforced or that cannot be monitored could pose problems for the success of the TWB. If an individual knows they can obtain additional water without the threat of punishment, there may be no incentive to purchase water through the TWB or similar entities.

Opportunity Cost and Price. Prices in commodity markets are constantly changing to reflect supply and demand conditions. Due to the ease at which individuals may enter or exit the market and under the assumption that the market incorporates all available information, the market price would reflect the true opportunity cost of the commodity.

Under the operational rules for the CDWB, the price paid to farmers per acre foot of water was $125. Which was determined by the "Water Purchase Committee." The opportunity cost of a resource will only be reflected in the price if it is determined by the market. The price paid to farmers was determined outside the market and then dictated to willing sellers. However, it is possible, that the price paid would in fact have been the same as the market clearing price. This is unlikely since the marginal
value of water for urban use has been estimated between $988-$1235/af, a price that might have been paid in a market outside the CDWB.

The policy on pricing in the TWB allows the buyer and seller to negotiate the terms. However, the TWB is available to help in the negotiating process. This is seen by some as leading to the utility based approach of the cost of water plus some allowable rate of return. At present the price is market determined and therefore can be considered as confronting the user with the true opportunity cost.

**Predictability and Fairness of the Process.** The studies that were conducted after the CDWB had operated provide insight into the predictability and fairness of the market process. Many of the farmers were wary about participating in the bank at first. They felt that continued participation could lead to the eventual adjudication of their rights. Alternatively, they felt that if they did not participate they could lose water through administrative control. Complaints surfaced about farmers receiving bank payments and still harvesting a crop or receiving federal subsidies to fallow land. However one of the biggest complaints about bank administration was the lack of information of the impact of the transfers on local economies and the environment. The view is that fish and game did not benefit from the bank and may have suffered damage.

For the TWB, predictability and fairness of the process is harder to determine since there have been no transfers through the bank. Although, the information gathering meetings that took place during the rulemaking process offers insight about the banking mechanism. Given that a large amount of water moves from irrigation use to municipal use some irrigation districts suggested that the districts commit a certain portion of their water rights to a reserve for cities to use in times of drought but allow farmers to use it during normal times. This would help reduce worry over the unpredictability of water movement between uses. However, it was not clear if the districts would be compensated for the option to use the reserves. They would be compensated if the cities took delivery of the water. An option market for water has developed along the Rio Grande already.

The banking process should be fairly equitable in its design. Sellers of water will be compensated at a price determined between the parties. However, parties affected at points of diversion or because of reduced instream flow are not necessarily compensated. In permanent transfers these parties do have an option to voice their opposition at hearings conducted on the proposed transfer.

**Nonrestricted Participation and Third-Party Effects.** In commodity markets, participation is open to any agent who has the funds to purchase contracts or has supplies to offer contracts. Third parties could or could not be affected if the agent that owns the contract decides to take delivery of the commodity or not.

In California, the water bank excluded many third-parties from the process. Membership in the bank was extended only to any corporation, mutual water company, or public agency that had the responsibility to supply water for agricultural, municipal and industrial, fish and wildlife or other uses in 1991. This limitation means that institutions such as the Sierra Club would not have access to purchase water for instream benefits.
Due in part to the limitations placed on third party participation and the nature of the CDWB, third parties were affected by the transfers. As shown in the previous section, income and employment decreased in those regions that exported water although this was more than offset in the importing regions. Fish and wildlife are thought to have not benefitted from the transfers and may even have been hurt. Individuals with wells in Butte County experienced an increase in the depth to water due to the increase in groundwater pumpage through the bank program.

The rules of the TWB have allowed anybody to participate. Deposits can only be made by those agents with a water right, but purchases can be made by any individual, corporation, municipality or environmental institution that can reach an agreement with the selling party. Because of the ability for third parties to participate in the TWB, this could lead to a reduction of negative third-party effects. However, if water is transferred out of the region through the TWB this could lead to the same outcome with regards to employment, income and groundwater depletion that was experienced in California.

**Measurement.** In commodity markets all contracts are standardized with regards to date of delivery, quality and quantity. The price is the only factor that can vary. For both the TWB and CDWB surface water rights are quantified. However, groundwater is not easily quantified in its stored state. Groundwater can be measured once it is pumped to the surface. The CDWB did allow as part of its program a replacement of groundwater for the surface water that was sold. For the TWB, groundwater may be deposited but then the question is how much. Estimates can be made in terms of yield but it is not as exact as surface water.

**Recommendations for the Texas Water Bank**

The TWB has been operating for seven years. However there has been little use of the Bank up to this point. Some of the possible reasons for the inactivity have been presented above, yet others remain to be discussed here.

There are a number of characteristics that are similar between the CDWB and the TWB. The research that examined the CDWB produced suggestions for improving the Bank might be improved. From these suggestions and the characteristics of an effective water market that are examined in Table 3, specific suggestions will be made about the TWB.

A major problem for the TWB seems to be a lack of information, especially by the majority of potential buyers, resulting in asymmetric information. The bank may not be widely known and only the major purveyors of water may know of its existence. 4 percent of right holders hold 90 percent of the water rights in the State of Texas [TWDB, 1997]. Information is available on the home page of the TWDB and at request but beyond those standard avenues for information no other attempt has been made to inform the remaining 96 percent of right holders. For markets to be effective there must be a large number of participants, not just participants with a large number of rights. By working through river and groundwater authorities the bank may be able to educate potential water bank participants.
The TWB personnel know that local decision making, with regards to water rights, is preferable to the State.

The question of groundwater banking needs to be answered and there seems to be a "wait and see" attitude at the TWB. Groundwater is not as easily quantified and transported as surface water. It may not be as easy to create a market for groundwater. Markets do exist such as in the West Texas Plains where cities are purchasing only water rights and then pumping that water to their municipalities. But authorities at the TWB are under the impression that groundwater banking would only entail one agent paying another, in the same aquifer region, not to pump during certain periods of the year [TWDB, 1997]. This is a possibility, but a more likely one is to extract the water from the property and transport it offsite as cities are already doing. It would be beneficial for the TWB to solidify the rules governing groundwater purchases especially in light of the Trans Texas Water Plan and the increased activity of municipalities. However, since the only advantage to depositing water rights in the bank is protection from cancellation, the Registry of Buyers and Sellers would provide the same function without the legal complications.

One of the reasons that there is more activity in the registry rather than the bank is the feeling by water right holders that they would have less control over their rights if deposited in the bank. The only difference between the bank and the registry is that surface water rights are protected from cancellation for an initial 10 years. Which exposes another weakness of the bank, the reasoning for cancellation of surface water rights.

Section 11.173 of the Texas Water Code allows for the cancellation of all or part of a surface water right that is not beneficially used during a 10-year period. The water code also defines and prioritizes beneficial use: (1) domestic and municipal uses, (2) industrial uses, (3) irrigation, (4) mining, (5) hydroelectric power, (6) navigation, (7) recreation and pleasure, and (8) other beneficial uses [Kaiser, 1993]. The problem develops when a water right holder has decided to lease his/her water instead of using it themselves. The leased water is being put to beneficial use but by another party but this would still be grounds for cancellation because of nonuse by the party that owns the water right. According to Water Bank personnel the reason for not changing the rule is to protect junior right holders. If water is not being beneficially used by a senior right holder, and that right is subsequently cancelled, that makes the junior right more senior [TWDB, 1997].

This distinction between beneficial use and nonuse of surface water may well be the one factor that limits the growth of water marketing in the State of Texas. Individuals may find that engaging in long term contracts is risky because of the possible cancellation of their water right. The State may find it beneficial to redefine the cancellation policy in light of the growth and benefits of water markets.

Conclusions

This chapter has focused, critically, on the development of a water market in the State of Texas. The goal of the TWB is to facilitate transactions between buyers and sellers of water. It was created by
the state legislature during a period of time when the issue of a reliable water supply for the citizens was of great concern. The question is: Has the TWB achieved what it was created for?

To better understand the role that the TWB is attempting to play it is important to understand well functioning commodity markets. The livestock and meat commodity markets along with the emission allowances market were examined. These markets are broad with the large number of buyers and sellers that participate. Given the nature of the market, transactions costs are minimized and prices are considered "pure" which are determined by the interaction of supply of the commodities and demand for the commodities. These markets are considered to be effective.

Previous experiences with water banking have taken place in California. The CDWB was established to facilitate the movement of water from Northern California to parched Southern California during the drought of the early 1990s. Farmers voluntarily joined the bank and created a surplus of water by either fallowing their crops or replacing the sold surface water with groundwater. Buyers of the water were municipalities or other agencies responsible for the delivery of water resources. Even though the CDWB created a market to transfer water, prices were not flexible and were set at $125 per acre foot by the Water Purchase Committee.

The experience of the CDWB provided the opportunity for a number of studies to be conducted. Part of what they found was that the water exporting regions suffered in terms of income and employment but the importing regions increased in both those areas. The net effect for the state was an increase in both income and employment. Other effects included groundwater overdrafting, reduced habitat for waterfowl and bitter feelings between farmers in some cases.

When analyzed, the characteristics of the TWB more closely reflected the commodity markets then it did the CDWB. The major difference is that prices are not determined by the TWB but by the seller and potential buyer. However, the TWB is experiencing problems with information dissemination which could be hindering its growth. Only one deposit is on record, and only 3 buyers and 10 sellers are registered.

For the TWB to become an effective mechanism for transferring water in a market based approach changes need to be considered. These might include: (1) redefining the conditions under which a surface water right would be cancelled; (2) increasing the awareness of the existence and function of the TWB; and (3) solidify the rules of groundwater banking.
References


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