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Spot Market for Water along the Texas Rio Grande: Opportunities for Water Management

ABSTRACT

As per capita water supplies in many regions of the United States and the world begin to decrease, a mechanism must evolve to transfer water to where it is needed. Water markets have become increasingly popular with water managers and state officials as a means of allocating or reallocating this resource. Along the Rio Grande in Texas, a spot market for water has developed that is very active, with all the attributes that a well-defined market should show. As a result, individuals from agriculture, municipalities, and industry have begun to rely on this market as a means to supplement shortfalls in their own supply.

INTRODUCTION

Markets are one of the means of allocating scarce resources among competing uses. The idea of markets as a mechanism for transferring water to its highest valued use has been forwarded by economists for some time.¹ From this view, markets that are competitive can allocate the resource effectively and have increasingly become a management component for local and regional water systems. As the demand for water increases and the per capita supplies for many regions not only in the United States but also around the world decreases, these markets can play a role in helping to alleviate the pressures of the increased demand.

The purpose of this article is to examine the recent activity in the spot market for water along the Rio Grande in Texas.² Both positive characteristics, which water managers may want to include in the development of their own markets, and negative characteristics, which they

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1. See generally Charles Howe et al., *Innovative Approaches to Water Allocation: The Potential for Water Markets*, 22 WATER RESOURCES RES. 439-45 (1986); BONNIE C. SALIBA & DAVID B. BUSH, WATER MARKETS IN THEORY AND PRACTICE: MARKET TRANSFERS, WATER VALUES AND PUBLIC POLICY (1987); Bonnie Colby, *Transaction Costs and Efficiency in Western Water Allocation*, AMER. J. OF AGRIC. ECON. (1990).

2. The section of the Rio Grande that this study is concerned with is the area administered by the Rio Grande Watermaster, which is the Amistad and Falcón reservoir system.

may want to avoid, are identified. To better understand the development of this spot market, an overview of the development of current water law in the state of Texas, along with the geographic and economic features of the region, will be presented.

FOUNDATIONS OF THE MARKET

Texas surface water, in contrast to underground water, is highly regulated. Texas surface water law and water rights evolved through a dual system, incorporating Spanish appropriation rights and English common law, which emphasized riparian rights. This dual system in Texas remained through the 1950s when drought conditions prevailed and total claimed water rights under the dual system exceeded available water supply. A 1956 court case led to the adjudication of Texas water rights on a case by case basis.³ As a result of this case, the Texas legislature brought about the merger of all riparian and appropriation water claims and established a procedure to resolve the claims and acquire new permits or transfer claims.⁴ This legislation, the Texas Water Rights Adjudication Act of 1967,⁵ also created the watermaster program to administer, monitor and enforce water rights in the state. Along the Rio Grande this is the Rio Grande Watermaster (RGW) Office, a part of the Texas Natural Resource and Conservation Commission (TNRCC).

The Lower Rio Grande Valley Water Case⁶ determined the water right allocation for each claimant and the priority of each water right. Essentially, municipal and domestic users receive top priority, followed by industrial users. Irrigation users rank third, although they have the single largest allocation as a group.⁷ The amount of water that may be applied to the beneficial use of agriculture was determined by the courts to be 2.5 acre-feet of water per acre of land per year.

Further decisions were made concerning water users. Class A water rights embrace those entities who acquired rights to use the Rio Grande by virtue of having complied with the appropriation statutes of the state of Texas or whose water rights were recognized by the state (i.e., certified filings). Class B water rights embrace those who have been making

3. See *Texas v. Hidalgo County Water Conservation and Irrigation Dist.*, 443 S.W.2d 728 (Tex. Ct. App. 1969).

4. See Otis W. Templer, *The Evaluation of Texas Water Law and the Impact of Adjudication*, 17 WATER RESOURCES BULL. 789 (1981); RONALD KAISER, HANDBOOK OF TEXAS WATER LAW: PROBLEMS AND NEEDS 19 (1987).

5. TEXAS WATER CODE ANN. § 11.301 (West 1998).

6. See *supra* text accompanying note 2.

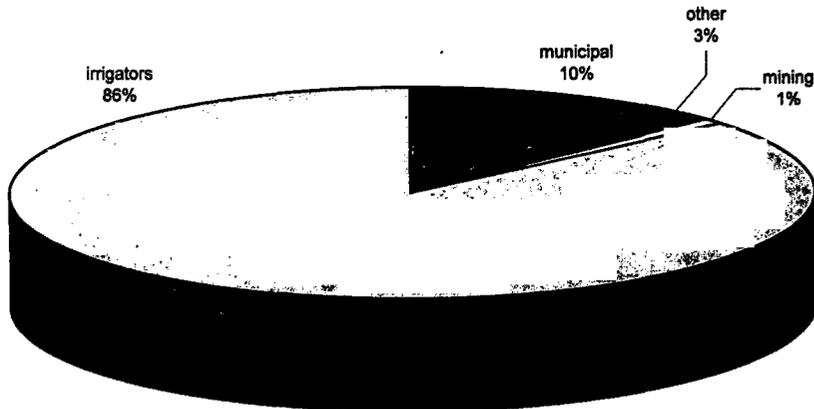
7. See Andrew Schoolmaster, *Water Marketing and Water Rights Transfers in the Lower Rio Grande Valley, Texas*, 43 PROF. GEOGRAPHER 292, 296 (1991).

"good faith" beneficial use of the waters of the Rio Grande for irrigation purposes prior to the institution of the lawsuit (1956). Class A water rights are allocated at a rate 1.7 times greater than Class B water rights.

This distinction is important since actual water rights do not necessarily mean this is the quantity allocated to individual irrigators each year. Some pro rata share is allocated depending on climatic conditions, storage levels at various dams, and Rio Grande basin inflows. For example, between 1978 and 1985 agricultural water rights holders received an average of 41 percent of their total allotment.⁸

As of September 1997 there were 813 active water rights along the entire Texas Rio Grande.⁹ By class of user, irrigation districts and individual irrigators represent the largest number of users. They hold 35 percent of the total water rights when hydroelectric water rights are included and 86 percent of water rights when hydroelectric is excluded. Municipal water rights holders represent 10 percent of claims to the Rio Grande when excluding hydroelectric. Mining rights make up around one percent of the total rights. There also exists a very small number of in-stream water rights for wildlife and environmental purposes. Figure 1 shows the breakdown of active water rights by class for the major participants in the spot market.

Figure 1



8. See Ric Jensen, *The Texas Water Market*, 13 TEX. WATER RESOURCES, Spring 1987, at 1 (Tex. Water Resources Inst., College Station, Tex.).

9. See Telephone Interview with Tex. Nat. Resources Conservation Comm'n (Sept. 1997).

Water use patterns in the United States and Mexico are similar, and demand for water along the border is increasing. The United States irrigates about 900,000 acres in the entire Rio Grande basin (versus 1.1 million acres in Mexico). Population growth along the border has also increased. During the 1980s, the United States' population increased 27 percent (from 1.13 to 1.55 million persons) along the Rio Grande, compared to 23 percent in Mexico.¹⁰ Supply availability of surface and groundwater is compounded by water quality concerns along the Rio Grande basin.

Rio Grande Watermaster

In natural resource economics, economic theory considers optimal use of renewable or nonrenewable resources. Optimal control theory yields familiar results: the basic stock-flow equations that incorporate private and social benefits and costs of resource use and the stock of that resource.¹¹ These results include evaluation of current and future use (sustainability) as well as multiple types of users (municipal/industrial and agricultural, third party, and instream ecological and environmental users). Theory is silent on who or what agency would dictate these optimal control results, but it is recognized that the market system alone would not achieve optimal results unless all resource benefits and costs went through the marketplace and water rights were well defined.

In a policy context, institutional control may provide an approximation to optimal control. The Rio Grande Watermaster office, administered by the TNRCC, is charged with monitoring the use, allocating the water, and enforcing those water rights laws and regulations established by the Hidalgo decision and the Texas legislature.¹² Institutional control is exhibited by the Rio Grande Watermaster (RGW) office through its functions of accountability, operations, and enforcement, which are important to the development of water markets along the Rio Grande.

The administrative offices of the RGW handle all accounts as to individual water rights. A computerized monthly report indicates the authorized water right (in acre-feet), any water use, and the water balance of individual users to date. Irrigation water rights not used in a particular year may be carried over as storage to the next year. Storage limits for irrigation rights are approximately 1.41 times the annual water right. Beyond that limit, the excess must be used, transferred or lost (the excess,

10. See Jean A. Bowman, *The Rio Grande: A Confluence of Waters, Nations & Cultures* 19 TEX. WATER RESOURCES, Summer 1993, at 2.

11. See generally CHARLES HOWE, *NATURAL RESOURCE ECONOMICS: ISSUES, ANALYSIS, POLICY* (1979).

12. See *supra* text accompanying note 2; Schoolmaster, *supra* note 7, at 296.

not the water right). In addition, water rights may be subject to cancellation if not used for a 10-year period.¹³

The operations function of the RGW determines the available water for all uses. This amount is based upon the flows of the Rio Grande, climatic conditions, and water levels at the two lower Rio Grande reservoirs (Falcón and Amistad). Water to municipal rights, the highest priority by statute, is allocated at the beginning of each year, with each municipality receiving a credit for its pro rata share of annual water rights to be distributed by the RGW. Municipalities thus have information as to their annual water deliveries and can determine if shortfalls are imminent.

Water to irrigation users is decided on a monthly basis by the RGW. A weekly report from the International Boundary and Water Commission (IBWC), which monitors the provisions of the United States-Mexico Water Treaty of 1944, provides information on storage levels at Amistad and Falcón reservoirs, average inflows and outflows and the U.S. share of these three variables.¹⁴

Users of all categories must request authorization to divert water. Information required includes the owner name and certificate number, when diversions from the Rio Grande are to begin and end, the rate of diversion (gallons per minute or cubic feet per second), total acre-feet of diversion request, and the pump number where diversion occurs. All diversions are controlled through releases from the reservoir and surveillance of diversion facilities.¹⁵

Each user has an associated travel time from the reservoirs. For example, the city of Brownsville is seven days downstream from Falcón reservoir. If water is requested on day one, it is received on day eight. Once water diversions are ordered through the RGW, cancellation of an order (i.e., if it rains) is costly, and 90 percent of the water ordered is still charged to the account.

Enforcement of water use and water diversions is a responsibility of the RGW as well. Water right balances and diversion requests are kept at the RGW offices. Watermaster deputies check diversions along the Rio Grande to ensure compliance with rules and regulations. There is little evidence of non-authorized use.

In traditional economic terms, the Rio Grande Watermaster is able to approximate an efficient water rights structure for United States' water use along the Rio Grande. Water rights are (1) completely specified, (2)

13. See James E. Jonish et al., *Water Marketing Along the Texas Rio Grande*, in PROC. OF THE UNIVERSITIES COUNCIL ON WATER RESOURCES ANNUAL MEETING 170, 171 (1996).

14. See Interviews with the Tex. Nat. Resources Conservation Comm'n, Rio Grande Watermaster Office (Aug. 5-7, 1993).

15. See *id.*

benefits and costs are accrued to owners, (3) rights are transferable, and (4) water rights are enforceable or secured from encroachment.

SPOT MARKET FOR WATER ALONG THE RIO GRANDE

In recent years, water transfers within Texas, and particularly along the Rio Grande, have accelerated. Water institutions in Texas have encouraged this development to a much greater extent than other western and southwestern states.¹⁶ However, markets do still exist in these regions.

Saliba identified markets where permanent rights were being transferred in New Mexico in the Gila-San Francisco Basin; in Arizona in the Phoenix and Tucson Active Management Areas; in Colorado in the Northern Colorado Water Conservancy District; in Utah in the Lower Sevier River Basin; and in Nevada in the Truckee River Basin.¹⁷ In the early 1990s the state of California instituted the California Drought Water Bank (CDWB). This modified market was created to facilitate the transfer of water from mainly agricultural interests to municipalities and industry.

Where the markets mentioned above differ from the Rio Grande is in size, scope, and life. The spot market for water along the Rio Grande has become a permanent fixture with numerous transactions each year. The CDWB, in contrast, was only temporary, but it did involve a large number of purchases without changing ownership of the water rights. The other markets mentioned by Saliba were primarily permanent transfers of water.

Along the Rio Grande, the terms of water market transfers reflect the broad-based characteristics of market exchange in general.¹⁸ The transfer may be *permanent*. This involves the exchange of water rights, with or without associated land ownership, from one entity to another on a permanent basis. The sale price represents the capitalized value of the water right over time. A permanent transfer from one user to another user class (irrigation to municipal) does require the approval of the TNRCC.¹⁹ The transfer may be on a *term*, or fixed period, basis. This type of contract promises to deliver a certain quantity of water for a specified period of time, up to one year. The contract price reflects the guaranteed delivery of water per year at a fixed price for the specified period of years. Transfers may be *spot* market transfers, a one-time exchange of a quantity of water

16. See generally Bonnie Colby, *Economic Impacts of Water Law: State Law and Water Market Development in the Southwest*, 28 NAT. RESOURCES J. 721 (1988); Chan Chang & Ronald C. Griffin, *Water Marketing as a Reallocative Institution in Texas*, 28 WATER RESOURCES RES. 879 (1992).

17. See Bonnie Colby Saliba, *Do Water Markets "Work"? Market Transfers and Trade-Offs in the Southwestern States*, 23 WATER RESOURCES RES. 1113 (1987).

18. See Jonish et al., *supra* note 13, at 172.

19. Texas Water Code Ann. § 11.122 (West 1998).

from seller to buyer. Transfer price here should reflect prevailing conditions (drought or abundance) at the time of transfer. Within the context of TNRCC rules, these three different water transfer categories are considered as two: permanent transfers of water and contracts for sale (covering term and spot categories above).

Finally, *option* contracts in water markets are emerging. These are contingency contracts with water deliveries based upon the occurrence of a set of particular circumstances. This may involve general drought contingencies and water reallocations, or excess demand sub-markets or users, linked to excess supply sub-markets or users. The transfer price here usually includes a fee to activate the option contract.

Far and above the most active market along the Rio Grande is the spot market. Why is this market more active than the other transfer possibilities? To answer this question it is necessary to compare the market along the Rio Grande as it is with a theoretical market structure. The characteristics of perfectly competitive markets include the following:

1. There are a number of firms, each producing a homogenous product.
2. Each firm attempts to maximize profits.
3. Each firm is a price-taker; it assumes that its actions have no effect on the market price.
4. Prices are assumed to be known by all market participants; information is perfect.
5. Transactions are costless.²⁰

Examining the first characteristic of a perfectly competitive market as it relates to the Rio Grande, the product in question is water. Spot market water is perfectly homogenous in nature. Since the transaction is on a one-time basis, no exchange of water rights takes place and therefore no varying class of water rights is involved. Quality of water is assumed not to have an impact on price because all buyers are drawing from the same source at their point of diversion.

There are over 813 active water rights along the Rio Grande. Therefore, there are a large number of potential buyers and sellers of spot market water. Given that the geographic scope of the market encompasses the Rio Grande from Amistad Reservoir to the Gulf of Mexico, along with the number of potential participants, the market can be considered broad.

Holders of water rights are both individuals and firms. Over 80 percent of the water rights along the Lower Rio Grande are held in the agricultural sector, with municipal, domestic and industrial users

20. See WALTER NICHOLSON, *MICROECONOMIC THEORY* 427 (1992).

accounting for the remaining share of water rights.²¹ It is assumed that each sector engages in profit maximizing (utility maximizing) behavior.

The RGW is in a unique position to disseminate information regarding water balances for individual entities. Since the RGW is required to keep current water balances for each individual right holder and every right holder is aware of this, individuals interested in purchasing water know there is one location where information can be obtained, the RGW office. Information is inexpensive (a phone call) and a search is relatively costless. Any transaction costs that do exist (search, paperwork and negotiations) are essentially fixed and low. The RGW office behaves like a broker of water, bringing buyers and sellers together, but does not charge a fee for these services.

Price is determined by negotiations between the buyer and seller of the water and not by the RGW. This characteristic is important since it allows for the price to fluctuate given changes in demand and supply. In addition, a competitive market that sets a market-clearing price also confronts the potential user with the true opportunity cost.²²

One of the important characteristics of the RGW office is that it monitors and enforces water rights effectively. Deputies continually patrol along the river and canals making sure that right holders are in compliance with regulations and no illegal pumping is taking place. This presence has reduced the likelihood of cheating that could be done by anyone with the means to capture the water.

During the dry summer of 1996, complaints were received by the TNRCC that water which was purchased from upstream reservoirs never reached its intended destination downstream. These complaints were mainly focused in the Brazos, Lower Colorado, and Concho River Basins where no watermaster program exists.²³ The protection of the water rights by monitoring allows for the value of the right not to be eroded. It is because the water holds value along the Rio Grande that an effective market has developed.

It is the nature of the spot market and its characteristics that have made it the most active water market along the Rio Grande. Since the transfers are on a one time only basis, the water right holder has continued ownership of that right. This might be a comforting aspect to right holders, especially in a region where rainfall and water flows can change dramatically from year to year and the majority of water rights holders are

21. See Chang & Griffin, *supra* note 16.

22. See Howe et al., *supra* note 1, at 440.

23. See TNRCC Water Resource Management, *Surface Water Rights in Texas: How They Work and What to Do When They Don't* (visited Mar. 3, 1997) <<http://www.tnrcc.state.tx.us/admin/topdoc/gi/228>>.

agricultural interests. In addition, the ease at which water can transfer hands in the spot market is advantageous. A permanent transfer would require hearings and approvals by the TNRCC and therefore a lengthy amount of time. A spot transfer can be made as quickly as in a day.

Market Activity

Although spot transactions for water along the Rio Grande have existed for quite a while, records of these transactions have only been kept since 1993. At this time the RGW office began to track a total of six variables that could be attributed to each transaction. These were the date of the transaction, buyer/seller, adjudication (permit) numbers, total acre-feet purchased, price per acre-foot, and the class of the buyer (irrigation, municipal, or mining).

Since the start of the record keeping in 1993 through August 31, 1998, there have been a total of 1,504 spot market transactions. Of this total, the water in 1,274 of the transactions was put to use in irrigation, 119 were for mining use, and 111 were for municipal use (see Table 1). Typically, irrigators are sellers of water to all three user groups, probably stemming from the fact that they are also the largest holders of water rights as a group. However, there is some anecdotal evidence that individuals are beginning to purchase permanent water rights for the sole purpose of selling water in the spot market.

Table 1
Spot Market Transactions Along the Rio Grande

Year	Mining	Municipal	Irrigation	Totals
1993	43	12	78	133
1994	23	30	156	209
1995	17	24	347	388
1996	12	17	291	320
1997	7	16	126	149
1998*	17	12	276	305
Totals	119	111	1274	1504

*1998 transactions are through August 31. Source: Rio Grande Watermaster Office.

Also of interest is how the market has evolved between April 1993 and August 1998. Table 1 breaks down the number of total transactions on a yearly basis and by user class. As the data in Table 1 show, the biggest users and water rights holders, irrigators, are also the most active in the spot market. Mining firms and municipalities participate but to a smaller

degree. Market activity in 1998, a dry year, had already surpassed the yearly total for 1997 by August 31.²⁴

Prices in the spot market for water are market determined. Even though the RGW is responsible for allocating, monitoring and enforcing water rights, the terms of the transfers, whether permanent or on a one-time basis, are left up to the parties directly involved. Over the period of the data the average price paid by irrigators was \$16 per acre-foot, municipalities paid on average \$19 per acre-foot, and mining firms paid \$514 per acre-foot (see Table 2). The average size, along with prices, of the transactions reveals important information about the market. Mining interests engage in relatively small transactions with regard to the number of acre-feet purchased (10) and pay on average 27 times more per acre-foot than municipalities. As would be expected, municipalities purchase large amounts of water, 546 acre-feet on average, to supplement their current water supplies but pay little more than irrigators do. Thus, even in this well functioning market, extremely large price differentials exist for a perfectly homogenous commodity, contrary to the theory of perfect competition.²⁵

Table 2
Price and Size of Spot Market Transactions

User Group	Average Price (per acre foot)	Average Size (acre feet)
Irrigation	\$16	194
Mining	514	10
Municipality	19	546

Source: Rio Grande Watermaster Office

CONCLUSIONS

The experience of the spot market for water along the Rio Grande in Texas is encouraging for individuals concerned with allocation and management of this resource. The characteristics of this specific market (well defined property rights that are enforced and transferable) have allowed it to evolve into a substantial reallocation mechanism. The result is that water is moving toward its highest valued use. Those individual entities with an excess supply of water can sell that surplus without

24. The year of 1997 was a wet year across the Southwest and especially along the Rio Grande, where rainfall totals were close to the yearly average by September 15.

25. For a more detailed discussion of the price differentials see David W. Yoskowitz, *Analyses of Water Marketing and Allocation Mechanisms in Texas (1997)* (unpublished Doctoral dissertation, Tex. Tech Univ.) (on file with author); Jonish et al., *supra* note 13, at 173.

changing the permanent nature of their right. This flexibility is an attractive attribute since individuals with a surplus one year might find themselves in need of their full allocation the next year. However, there is still room for improvement in this active market. If it were to organize in a formal fashion, this might help improve the quantity and quality of information, reduce the price differentials, and give the market even more breadth.

Similar water markets exist in one form or another along other rivers in the western United States. However, none is as extensive and active as the Rio Grande spot market. For managers or river authorities interested in developing a similar market, the key to success along the Rio Grande has been rights that are well defined, enforceable, and transferable. Enforcement is especially important, otherwise there is the opportunity for "cheating" and therefore no incentive to purchase water through a market mechanism. Secondly, enforcement will protect the value of the right.