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# WATER LEASING: OPPORTUNITIES AND CHALLENGES FOR COLORADO'S SOUTH PLATTE BASIN<sup>1</sup>

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Presented at WAEA Annual Meeting  
June 26th, 2008  
Big Sky, Montana

## ABSTRACT

Burgeoning populations are increasing municipal water demand in Colorado, a phenomenon that is changing rural and urban economies. Agricultural water is a preferred source for meeting growing demands, but transfers often require formerly irrigated land to be fallowed, thus removing a key industry from rural regional economies.

One alternative to such 'buy and dry' strategies that is gaining interest allows farmers to lease a portion of their water portfolio to cities. Water is made available for lease as farmers fallow their land on a rotational basis or reduce the consumptive use of their cropping operations by limiting irrigation.

But will farmers adopt limited irrigation strategies if water lease markets materialize? This research considers whether farmers are willing to sign leases if suitably compensated; what remuneration is needed for a farmer to enter into a lease agreement; how much water the farmer will release when compensated; what provisions are desired in a lease agreement; and what characteristics are shared by farmers willing to lease.

Research results are useful for policymakers who may need to alter existing institutions so that the transactions costs of leases do not outweigh the potential gains from trade, and for farmers and municipal water providers actively engaged in developing water leasing alternatives.

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<sup>1</sup>This project was supported by the National Research Initiative of the Cooperative State Research, Education and Extension Service, USDA, Grant # 2006-55618-17012, the Colorado Agriculture Experiment Station and a cooperative agreement with the Parker Water and Sanitation District.

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Potential adoption is gauged from a survey of irrigator’s in Colorado’s South Platte River Basin, a basin experiencing significant population growth in the midst of significant agriculture production. The results indicate that more than 60 percent of the respondents are willing to lease, garnering between 50,000 and 60,000 AF of potential water supplies.

## INTRODUCTION AND BACKGROUND

As Colorado’s population continues to grow and urbanize, water will continue to be reallocated from agricultural to M&I uses. The significant negative impacts associated with permanent rural-to-urban water transfers call into question the economic viability and social acceptability of such transfers.

While individual buyer and seller presumably benefit from the transaction, stakeholders believe that rural economies are at risk. An economic incentive exists for water transfers and, presumably, the buyer and seller of water in a market transaction gain from the transfer. However, rural-to-urban water transfers often require formerly irrigated land to be fallowed, which removes a key base industry from rural regional economies and affects more than just the buyer and seller—third parties such as local governments and other local businesses are affected as well. There are reductions in retail trade associated with agriculture, which may in turn spur population out-migration. Impacts are felt by businesses and local governments whose property and sales tax base is eroded due to the lower appraised value of land as it is taken out of irrigation (Pritchett, Frasier, and Schuck, 2003). Additionally, there are environmental concerns regarding erosion, weed control, and the loss of open space.

The Statewide Water Supply Initiative (SWSI) has projected the population, annual water demand, and the resultant reduction in irrigated acres in Colorado by the year 2025 (Table 1). Using SWSI’s projections, Thorvaldson and Pritchett (2006) estimate the economic activity generated by irrigated agriculture and the economic impact of reduced irrigated acreage in three of Colorado’s river basins (Table 1).

**Table 1. Economic activity generated by irrigated agriculture and economic impacts of reduced irrigated agriculture<sup>a</sup>**

Basin	Population Increase	Additional Water Demand	Loss of Irrigated Acres	Economic Impact	Economic Activity \$/ac
Arkansas	55%	98,000 AF	47,500	-\$20,300,000	\$428
Rio Grande	35%	43,000 AF	80,000	-\$107,000,000	\$1,235
South Platte	65%	409,700 AF	159,500	-\$110,100,000	\$690

<sup>a</sup>Population, water demand and lost irrigated acres drawn from SWSI (Colorado Water Conservation Board, 2004). Thorvaldson and Pritchett (2006) provide economic impact and economic activity estimates.

Notable is the South Platte, which expects to fallow as many as 266,000 (twenty-two percent) of its irrigated acres in the next twenty-five years. Each irrigated acre generates significant economic activity in the basin, so potential losses are substantial in sparsely populated rural areas with few other alternatives. Impacts include the direct impacts via loss of crop sales; indirect impacts via lost revenues to agribusinesses that supply irrigated farms; and induced impacts via lost wages spent by affected employees.

A viable and healthy agriculture industry is essential to maintaining the economic, social, and cultural integrity of many rural communities. It is no surprise that large-scale transfers are greeted with highly-charged, emotionally contentious debates. Thus, the viability of emerging alternatives to permanent transfers needs to be examined.

Some stakeholders believe that temporary water leases in place of permanent transfers may avoid these negative externalities. Some form of limited irrigation is better for the regional economy compared to fallowing or converting large swaths of land to dryland cropping. Simply put, limited irrigation provides greater direct, indirect and induced economic activity. While not as large as the economic activity under full irrigation, the economic activity generated by limited irrigation is greater than that for dryland cropping (Pritchett, 2007). Importantly, the limited irrigation cropland remains in production so that rural economies suffer reduced effects compared to buy-and-dry activity.

Rotational fallowing and limited irrigation are two alternatives being explored<sup>4</sup>. Both involve agricultural water right holders signing leases with cities rather than selling water rights. In a rotational fallowing arrangement, a large group of agricultural water right holders sign a long-term lease agreement with a municipality and then shift fallowed acres from one farm to the next annually to spread lost economic activity over a greater landscape. Limited irrigation strategies include timing irrigations during vegetative growth and adopting innovative crop rotations. Importantly, the limited irrigation cropland remains in production so that rural economies suffer reduced impacts vis a vis buy and dry activity.

Leasing of this type is rare in Colorado<sup>5</sup>, and it is uncertain if leasing markets will evolve. Following the example of Michelson and Young (1993), necessary conditions for water lease markets include a critical mass of willing leasers and lessees so that both are reasonably assured of a mutually beneficial transaction; that the gains from leasing exceed the transactions costs; and that leasing contracts can be written, monitored, and enforced effectively.

This study examines the viability of water leases, from the perspective of agricultural water right holders in the South Platte Basin. In particular, this study examines i) whether farmers are willing to sign leases if suitably compensated; ii) what remuneration is needed for a farmer to enter into a lease agreement; iii) what lease stipulations are preferred by farmers; iv) how much water the farmer will release when compensated; and v) what characteristics are shared by farmers who are willing to lease.

Research results are particularly useful for policy makers who may need to alter existing institutions so that the transactions costs of leases do not outweigh the potential gains

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<sup>4</sup> With rotational fallowing, a large group of agricultural water right holders sign a long term lease agreement with a municipality, but then shift fallowed acres from one farm to the next annually to spread lost economic activity over a greater landscape. Limited irrigation decreases a crop's consumptive use without fallowing, and the water savings are leased.

<sup>5</sup>Leasing agricultural water to farmers is standard practice in Colorado, and municipal water suppliers do frequently lease out of basin water to farmers. These leases do not require legal oversight, but the leases described in this section would require approval.

from trade. The results are also of interest to farmers and municipal water providers that are actively engaged in developing water leasing alternatives.

## METHODS

A questionnaire was mailed to farmers in Colorado's South Platte River Basin, a basin that is experiencing significant population growth in the midst of significant agricultural production. The questionnaire had two main sections: 1) farmer and farm operation characteristics, including irrigation water source, the prevailing crop rotation, and financial demographics, and 2) attitudes about leasing arrangements, including willingness to participate, compensation, and contract provisions.

The questionnaire was mailed to farmers who reported more than fifty irrigated acres in the 2002 Census of Agriculture. Mailing began during the first week of September 2007 using procedures outlined by Dillman (2007), with a postcard reminder mailed ten days later and a second survey mailing twenty-one days after the initial mailing. Of the 1,731 successful mailings, 329 (19%) were returned and could be used in the analysis. A copy of the survey instrument is available from the authors upon request.

A binary logit model identifies the key characteristics that determine which farmers are more likely to lease their water. The necessary components of a functioning water lease market are uncovered and a supply function for water for leasing is estimated.

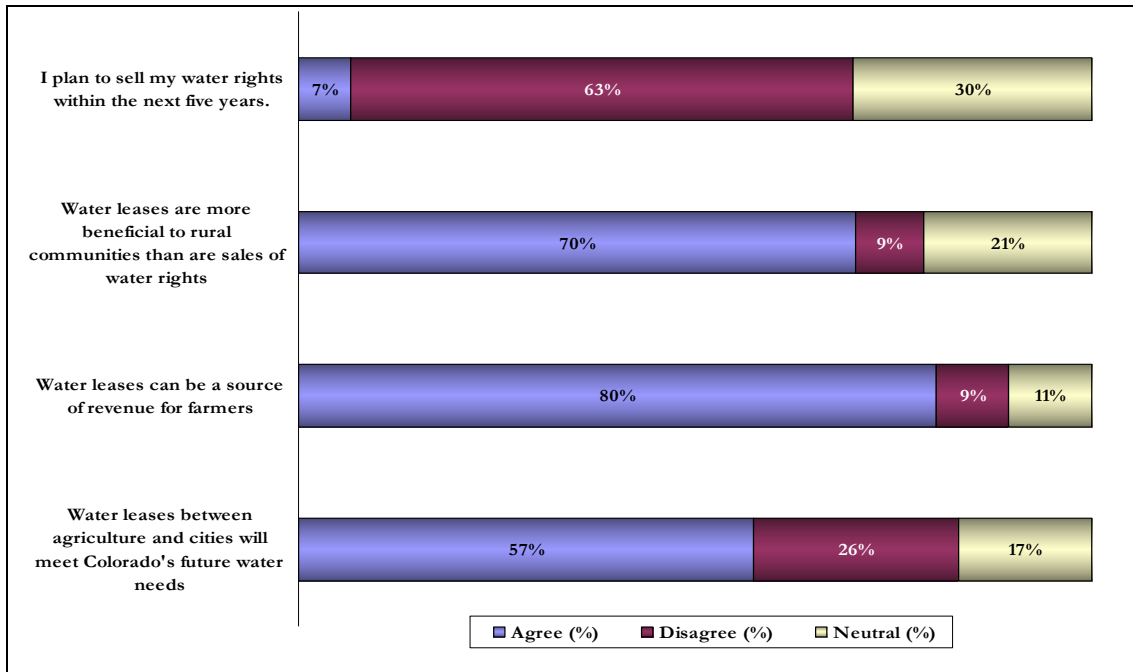
## RESULTS

### Leasing Attitudes

A leasing market's success or failure will have much to do with farmers' attitudes about leasing. Attitudinal surveys are often scored using a Likert scale, which generates data in the form of ordered responses. Probably the most common example, and the one used here, is the extent of agreement with a statement, as indicated by selection of one of five responses: *strongly disagree*, *disagree*, *neither agree nor disagree*, *agree*, or *strongly agree*. If a respondent strongly agreed with the statement, the response was given a 5 value, whereas *agreed*, *neutral*, *disagreed*, and *strongly disagreed* responses were given values of 4, 3, 2, and 1, respectively. The average rating among survey respondents was tabulated, and the percent of those who agreed with the statement (those responding with a 5 or 4) was calculated along with the percentage that disagreed with the statement (those responding with a 1 or 2). The results to a subset of the questionnaire's leasing attitude statements are displayed in Figures 1, 2, 3, and 4.

Figure 1 displays respondents' general beliefs regarding the possibility of water leases. As indicated by the figure, fewer than seven percent of respondents expect to sell their water rights within five years, which is encouraging—if water sales were *more* likely, the chance of successful water leasing arrangements between farmers and water providers would be *less* likely. The majority of respondents believe that water leases can be a source of revenue for farmers and that water leases are more beneficial to rural communities than are water sales. A smaller majority agrees that water leases will help

meet Colorado’s future water needs. The relative ambivalence toward the success of water leases may be because additional reservoir projects, increased municipal conservation, and inter-basin pipelines are generally supported by Colorado’s agricultural organizations, such that respondents may see leases as just one part of the solution to complex water demand issues, rather than the whole solution.

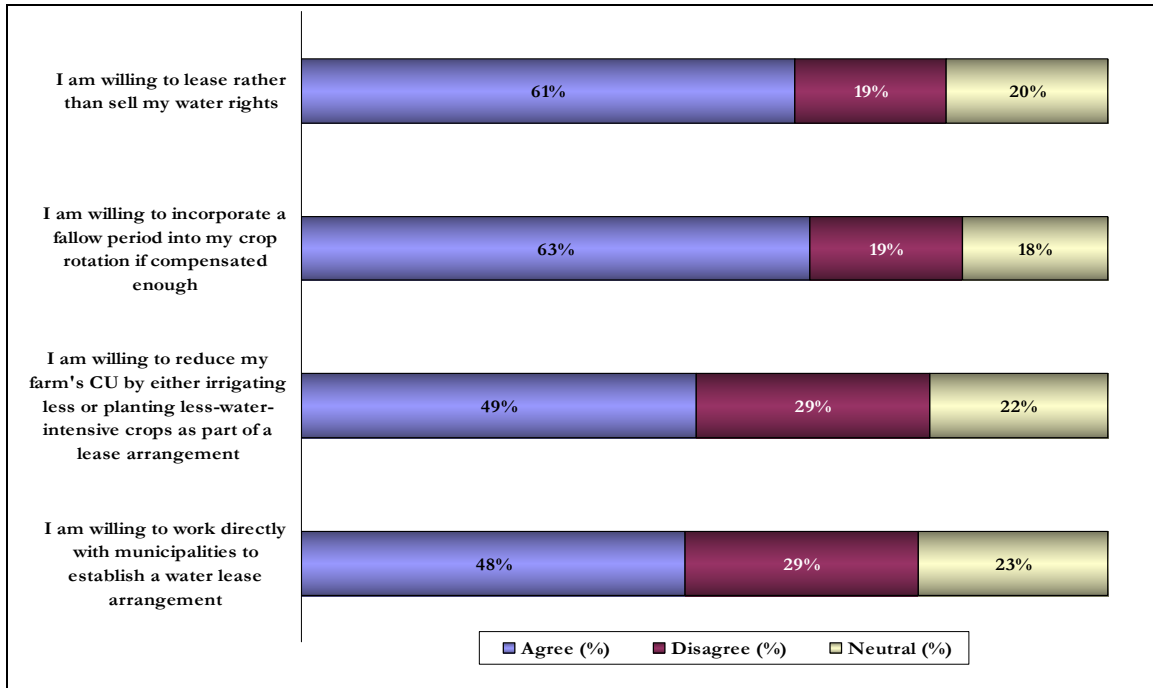


**Figure 1. Respondents’ general attitudes toward leases**

Once it has been established that farmers generally think that water leases are better for agricultural communities than are permanent transfers, it remains to be seen if individual farmers are themselves willing to enter into a lease agreement. Figure 2 displays respondents' individual willingness to participate in water lease arrangements. As shown in the figure, 61 percent of respondents indicate that they would be willing to sign a lease arrangement if suitably compensated, a value that stands a test of internal validity when juxtaposed against similar questions occurring later in the survey.

While rotational fallowing is acceptable to 63 percent of respondents, fewer respondents were willing to adopt limited irrigation strategies. Farmers may be more hesitant to adopt limited irrigation programs because the agronomical and financial ramifications of such programs are less familiar and less certain. Under limited irrigation, the farmer would be trying new crop mixes and/or timings of irrigation timing, etc., that are unfamiliar and yield uncertain outcomes. Under a fallowing program, on the other hand, yields and revenues can be better predicted—namely, zero when fallowing and typically expected full-irrigation values when irrigating. Additionally, limited irrigation programs may require more intense management, which many farmers may find discouraging. Finding the ideal timing and amount of irrigation may prove difficult, and changes in equipment and inputs may be necessary.

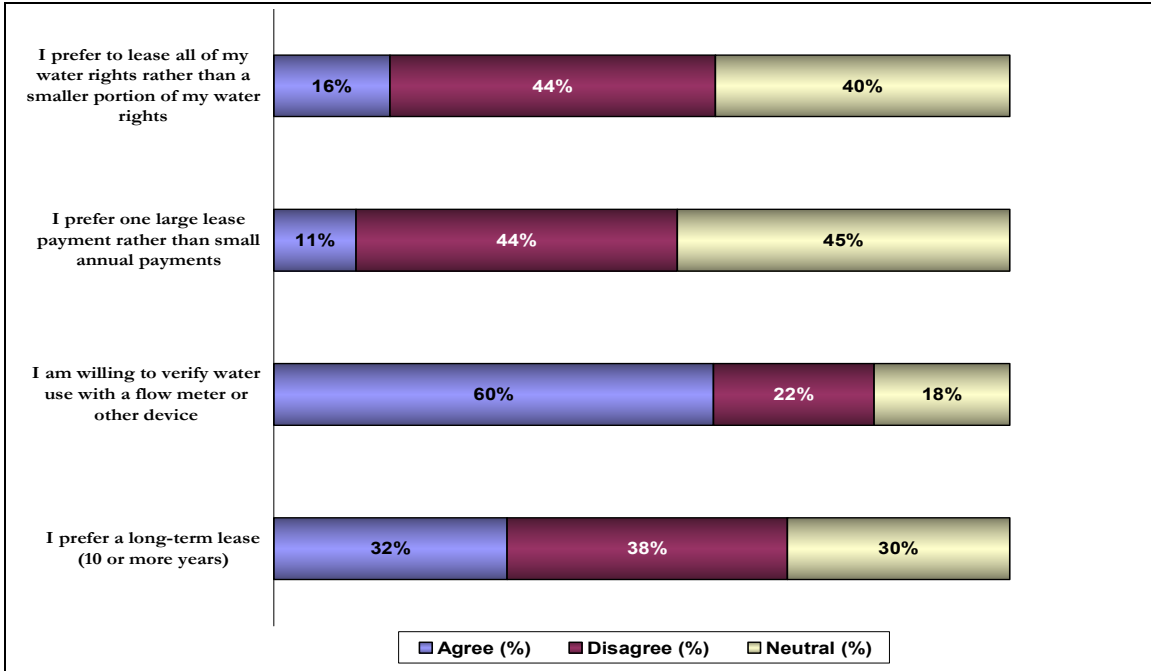
This information is useful to researchers, who have the opportunity to explore the expected outcomes of limited irrigation programs. Indeed, a multidisciplinary group at Colorado State University is currently exploring the agronomic and economic ramifications of limited irrigation using test plots of land and complex modeling systems<sup>6</sup>. This information is also useful for policymakers, who may find greater success investing their resources in a rotational fallowing program.



**Figure 2. Respondents' willingness to participate in a lease**

Figure 3 displays some of the lease provisions desired by respondents. More respondents prefer to lease a portion, rather than all, of their water rights. Additionally, more respondents prefer smaller annual payments rather than one large payment. Respondents are evenly split in their preferences regarding the length of the lease: 32 percent prefer a long-term lease, 38 percent do *not* prefer a long-term lease, and the remaining thirty percent are neutral.

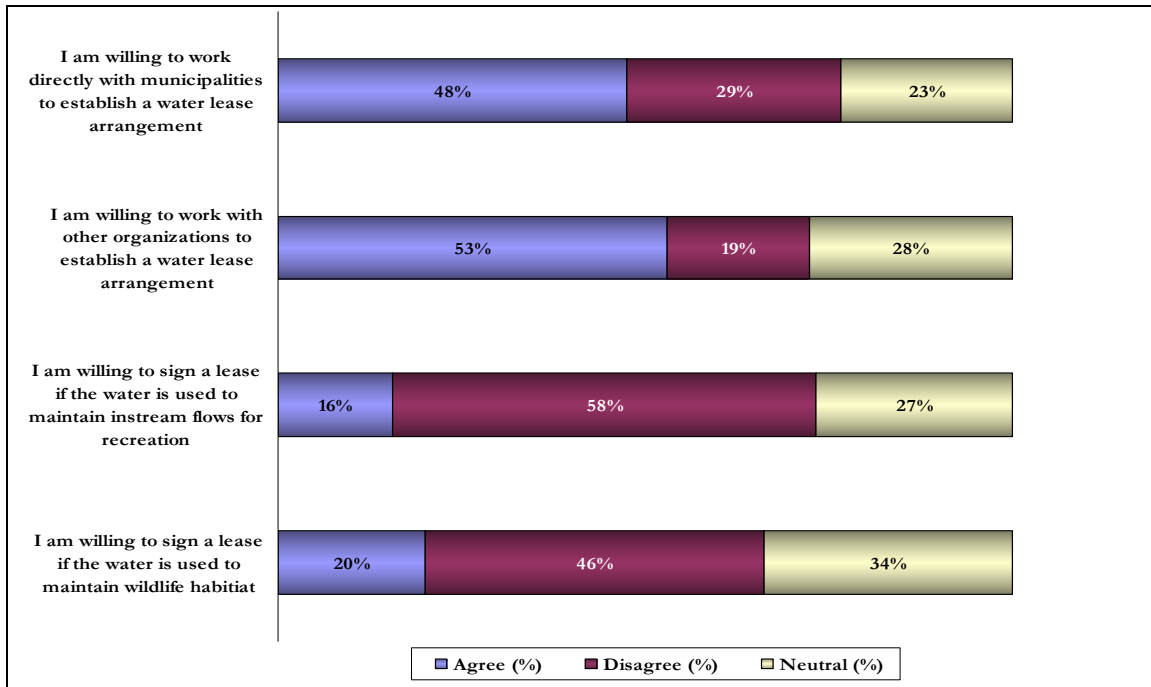
<sup>6</sup> Additional information on the limited irrigation project can be found at the following website: <http://limitedirrigation.agsci.colostate.edu/>.



**Figure 3. Lease provisions desired by farmers**

Figure 4 displays additional provisions that respondents prefer in leases and the lease negotiation process. Less than half of all respondents are willing to negotiate directly with a municipality to lease water, perhaps leaving negotiations to their existing ditch companies, mutual associations, or another institution that may evolve in the future. Indeed, a greater percentage of respondents are willing to negotiate with other organizations when developing lease agreements. Although the majority of respondents responded favorably regarding a willingness to lease, much smaller proportions of respondents would be willing to lease their water if that water was used for wildlife or recreational purposes.





**Figure 4. Respondents' preferences regarding leasing partners and use of leased water**

Based on these stated preferences, respondents have a generally favorable view of the impact that leases will have for farmers and rural communities. Many respondents are willing to sign leases if suitably compensated. In the next section, attention is focused on those survey respondents who were willing to lease or indicated a price at which they were willing to lease water<sup>7</sup>.

### **Respondents Willing to Lease: Characteristics, Prices, and Fallowed Land**

Identifying the key characteristics that are shared by South Platte farmers who expressed a willingness to lease will help to better forecast how many farmers would be willing to participate in a leasing program basin-wide, as well as identify potential incentives and barriers to water lease markets.

To this end, a binary logit model was used to identify the distinguishing characteristics of those farmers who expressed a willingness to lease. Survey responses of *disagree* and *strongly disagree* were assigned a value of zero, signifying an *unwillingness* to lease, while responses of *agree strongly* and *agree* were assigned a value of one, signifying a willingness to lease. This binary dependent variable was specified to be a linear function of the following explanatory variables, plus an error term:

1. Demographic and socioeconomic characteristics of the farmer: age; education level; and whether or not the farmer has a second job.

<sup>7</sup>In one survey section, respondents were asked to indicate if they were willing to enter into a water lease if compensated enough, and in a later section respondents were asked to indicate how much they must be compensated to forgo irrigation for one year. If respondents agreed or strongly agreed with the former, or indicated a lease amount to the latter, then their responses tabulated as potential lessees.

2. Characteristics of the farm: percent of irrigation water that is groundwater; size of farm (as indicated by the number of irrigated acres); farm location (represented by a dummy variable for proximity to an urban center. ); and debt (represented by a dummy variable for high debt, defined as a debt-to-asset ratio greater than 0.4).
3. Opinions of water leases and agriculture: willingness to work with municipalities in arranging lease agreements; willingness to work with other organizations in arranging lease agreements; whether the farmer plans to upgrade his/her irrigation system dedication; whether or not the farmer plans to sell his/her water rights; and whether or not the respondent believes that leases will be more beneficial to rural communities vis a vis the outright sale of water rights (an indicator of concern for rural communities).

Table 2 displays the results of the ordered logit results from regressing willingness to lease on farm and farmer characteristics. Two variables were found to have a statistically significant negative impact on willingness to lease: percent groundwater use, high levels of which preclude one from leasing water, and proximity to urban centers, which suggests increased pressure for urban development and thus a greater chance of selling the land and accompanying water rights.

Variables that were found to have a statistically significant positive effect on willingness to lease include concern for rural communities, willingness to work with municipalities, willingness to work with other organizations, and farming experience, which has a positive but diminishing effect on willingness to lease.

General concern for rural communities was measured by degree of agreement with the statement, "Water leases are more beneficial to rural economies when compared to the sale of water rights." In light of the fact that the majority of farmers believe that water leases are more beneficial to rural communities than are permanent water transfers, it makes sense that farmers who have a general concern for rural communities are more willing to lease their water.

A willingness to negotiate directly with municipalities increases a farmer's willingness to lease. Yet, many farmers have long-standing feelings of mistrust towards cities and less than half of respondents of this survey indicated a willingness to work directly with municipalities. This leaves opportunity for municipalities to undertake a public relations campaign and/or for other independent organizations to take on the role of negotiator between municipalities and water rights holders. Fortunately, a willingness to work with other organizations also increases a farmer's willingness to lease, and a greater percentage of respondents stated a willingness to work with other organizations when formulating a lease agreement.

Finally, the results indicate that willingness to lease increases at a decreasing rate with farming experience. Farmers who haven't been in the business for long may not be as dedicated to the farming lifestyle or tied to the community, and thus may be more apt to sell their water rights if the opportunity presented itself. More experienced farmers likely enjoy the lifestyle (otherwise they wouldn't have been doing it this long) and they have

likely invested a large amount of time and money on their farming operation, such that they are more willing to enter into a lease agreement if it means being able to keep their farm in operation. However, as experience is increased further, it has less and less of a positive effect on willingness to lease. Older farmers may be nearing retirement and may have no one to pass their farm on to.

**Table 2. Farm and farmer characteristics that influence potential participation in water leases**

Explanatory Variable	Coefficient	Standard Error <sup>8</sup>	z-Statistic	Probability
Constant	-4.6203	1.3384	-3.4522	0.0006
Experience*	0.0996	0.0482	2.0649	0.0389
Experience <sup>2</sup> *	-0.0012	0.0006	-1.9446	0.0518
Concern for rural communities*	0.9627	0.4189	2.2982	0.0215
Debt	-0.7559	0.4948	-1.5278	0.1266
Second job	-0.2365	0.3903	-0.6058	0.5446
Education level	0.0145	0.1519	0.0953	0.9240
% Groundwater use*	-0.0165	0.0065	-2.5283	0.0115
Irrigated acres	0.0004	0.0004	1.0045	0.3152
Proximity to urban center*	-1.6208	0.4303	-3.7667	0.0002
Plan to upgrade irrigation system	-0.1247	0.4015	-0.3106	0.7561
Willingness to work with municipalities*	0.5593	0.1845	3.0321	0.0024
Willingness to work with other orgs*	0.7027	0.2112	3.3273	0.0009
McFadden R-squared: 0.2537		H-L Statistic: 14.7010 (Pr = 0.0652)		
Log-Likelihood: -87.2069		LR Statistic: 59.2991 (Pr = 0.0000)		
Restricted Log-Likelihood: -116.8564		Akaike Information Criterion: 1.1518		

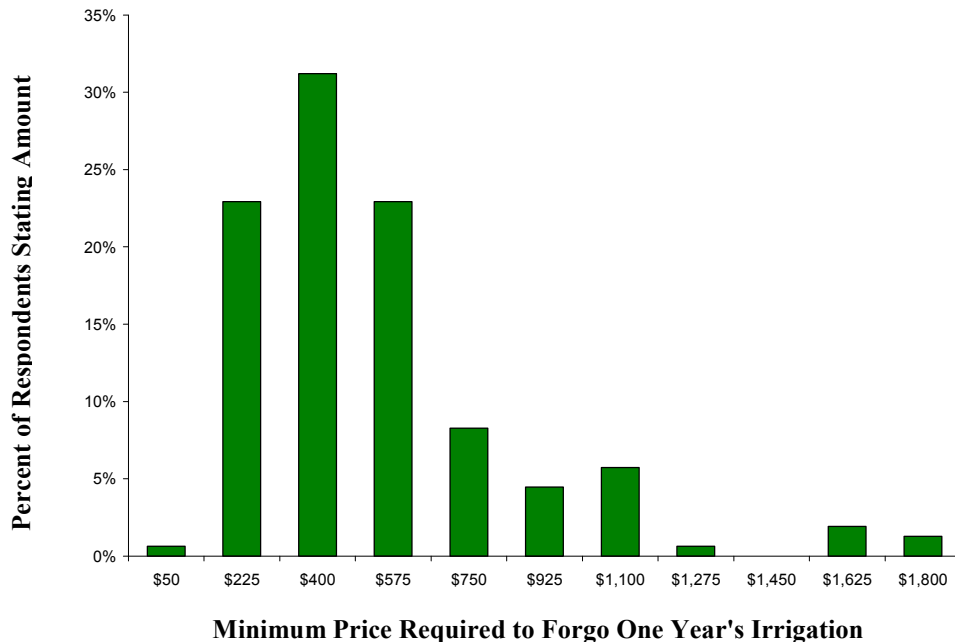
\*Statistically significant,  $p < 0.05$

## Pricing Water Leases

The price at which farmers are willing to lease water is important. As noted previously, a necessary condition for leasing to occur is that the gains from leasing, calculated as the price difference between the willingness to accept on the part of water right holders and the willingness to pay of water providers, must exceed the transactions costs<sup>9</sup> of executing the lease. To address this issue, respondents were asked the *minimum* price they would have to be paid in order to forgo irrigation for one year as part of a leasing arrangement--an example of rotational fallowing. These responses were collected into the histogram shown in Figure 5, which measures pricing intervals as column bars whose labels refer to the intervals' uppermost bound. The proportions of respondents that fall within the interval are measured on the vertical axis. For example, 23 percent of respondents indicate a required payment in the range of \$50 per acre to \$225 per acre.

<sup>8</sup> QML (Huber/White) standard errors and covariances

<sup>9</sup> Transactions costs include, but are not limited to, the costs of collecting, conveying and treating water, legal costs, financing costs of paying the lease, risk premium associated inadequate supplies during drought, and the costs to maintain fallowed farmland.



**Figure 5. The minimum lease payments respondents seek for forgoing one year's irrigation (\$/ac).**

The vast majority (77 percent) of responses populate an interval between \$225 per acre and \$575 per acre. A market analogy can be found for the lower end of this interval – at the time the survey was received, cash rent for irrigated cropland averaged \$300 per acre with dryland alternatives netting less than \$50 dollars per acre. The opportunity cost of forgoing irrigating cropping can be considered the difference between irrigated and dryland cash rents plus the cost of weed management and irrigation equipment maintenance. If this opportunity cost is \$300 per acre and two acre-feet (AF) of water may be leased, then the opportunity cost is valued at \$150 per AF. It follows then that the present value of a long term lease, assuming a 5% average rate of return, is \$3,000 per AF. Recent sales of water bought and sold for agricultural use in the South Platte Basin have traded in the range of \$3,000 per AF (Water Colorado).

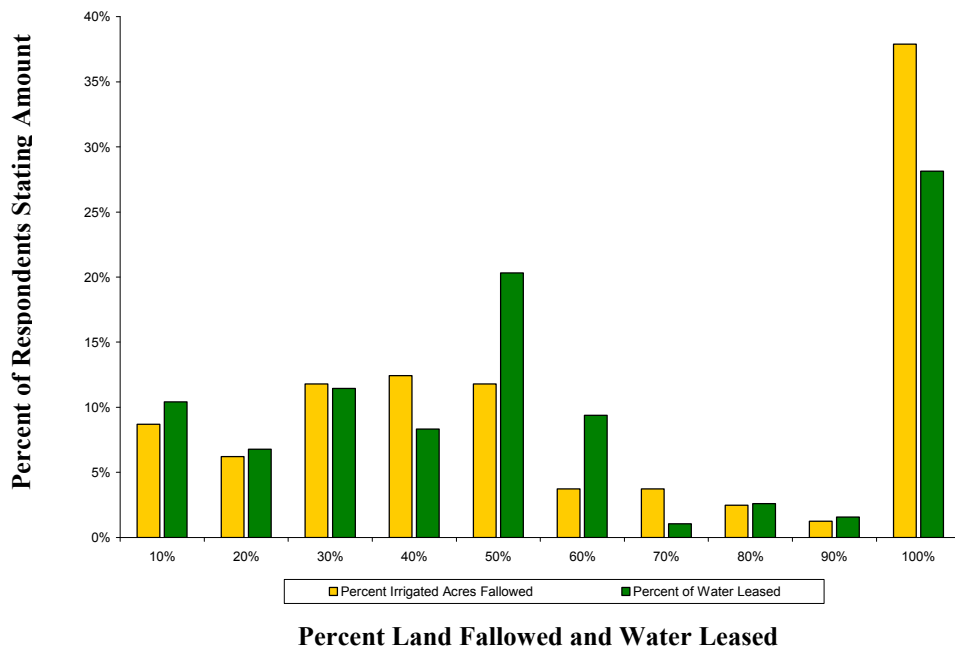
However, a number of respondents indicated a minimum lease payment of more than \$1,000 per acre as is indicated in Figure 5. Following the calculations outlined in the previous paragraph, the imputed value of water in this case is \$10,000 per AF or more. Interestingly, this value is representative of recent water sales of agricultural water bound for municipal use (Water Colorado). Perhaps, then, these farmers are calculating a market value for their water rather than a minimum payment to forgo irrigation.

### **Leased Water Quantities**

Survey respondents state a willingness to lease water and will do so at a price that is within the bounds of current water transactions. It remains to be determined if a sufficient amount of water is available to encourage leasing markets to evolve.

In the context of rotational fallowing, respondents were asked to indicate the percent of available water they would be willing to commit to an annual lease, the amount of land

that would be fallowed as a result of a lease, and the total irrigated acres that they held. On average, respondents will fallow 200 acres per respondent. A more detailed illustration of these responses is found in Figure 6. The columns labeled on the horizontal axis are of two types: the lightly shaded bars indicate the percent of all irrigated acres that respondents were willing to fallow in a lease, while the darker bars indicate the percent of irrigation water that might be committed to a lease. For example, twelve percent of respondents were willing to fallow fifty percent of their irrigated acreage as part of a leasing agreement, while twenty percent of respondents were willing to commit half of their water to a lease.



**Figure 6. Respondents’ percent of all irrigated acres fallowed and the percent of all water supplies committed to an annual lease.**

In examining Figure 6, respondents tend to cluster into two groups – those that are willing to commit all of their land and water to a lease (right-hand side of the figure), and those that are willing to commit half of their holdings or less to a leasing arrangement. It is encouraging that one-third of respondents are willing to lease all of their water--this provides evidence that there would be sufficient water supplied to make the transaction economically viable, since it would likely cost more to collect, treat, and transport water from many small sources than a few large sources.

At the same time, it is encouraging that not all respondents fall into this cluster, as that would leave little water in agriculture, and would yield similar impacts as a 'buy and dry' scenario. Respondents in the left-hand cluster are likely to stay in farming, which will provide economic activity and help avoid the ‘hot spot’ problem of concentrated clusters of acres taken out of irrigation

In total, respondents indicated they would fallow 33,352 acres. This would free between 50,000 and 67,000 AF of water annually<sup>10</sup>, an amount that is likely sufficient to make leasing a viable option for cities. This amount could fill approximately fifteen percent of cities' total needs; thus, it won't entirely solve the problem but will go long way to help it.

In the present analysis, water is characterized as a homogeneous commodity, while in reality the prior appropriations doctrine creates a heterogeneous water product whose value varies with the seniority of its appropriation. A leasing market may thus prove to be too "thin" if the water made available by farmers is of relatively junior priority, and municipal water providers instead seek scarcer, senior water rights.

## **CONCLUSIONS AND FUTURE OPPORTUNITIES**

Reallocation of water from agricultural to municipal use is inevitable given the rapid population growth of the heavily urbanized West. These water transfers are controversial largely because they may fallow large swaths of irrigated lands that often make up a significant portion of the local rural economic base. In place of these 'buy and dry' transfers, stakeholders are interested in the opportunity to create water leasing markets to partially meet future demands.

Analysis of the stated preferences of South Platte farmers who answered a questionnaire mailed in September 2007 indicates that a significant amount of water may be leased at a reasonable price. The majority of respondents believe that leases can be a source of revenue for farmers and that rural communities are better off with leasing arrangements relative to permanent water transfers. When asked to indicate the minimum price they must be paid in order to forgo irrigation for one year as part of a leasing arrangement, the majority of responses populate an interval between \$225 per acre and \$575 per acre. In sum, respondents indicated they would fallow 33,352 acres (an average of 200 acres per respondent). Important characteristics of those willing to lease include having more farming experience, having concern for rural communities, and being willing to work with municipalities and other organizations to orchestrate lease agreements.

Before leasing markets evolve in the South Platte Basin, the willingness to pay of municipal water suppliers needs to be revealed and the transactions costs of leasing markets needed to be examined. Transactions costs have been measured by Colby (1990) but an update is needed to determine if leasing arrangements incur the same costs as permanent water transfers.

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<sup>10</sup> Actual amount will depend on how water courts evaluate their historical consumptive use.

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