Household Willingness to Pay for Playa Restoration

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Abstract: Playas are small wetlands, averaging 14 acres in area, which periodically fill with rainwater and evaporate, and are not connected to any other body of surface water. On the Texas High Plains, the roughly 17,000 existing playas are a source of recharge for the Ogallala aquifer and the greatest concentration of biodiversity. However, when land surrounding playas is farmed intensively, sediment carried by rainfall and irrigation fills the playa floor and inhibits the ability of a playa to recharge the aquifer and to provide habitat for native plants and animals. Playas that are surrounded by grassland seep water towards the aquifer four times faster than playas surrounded by cropland. Currently, only 5% of playas in the region function naturally. Playas can be restored, however, by removing sediment and converting a 50-yard buffer around each playa to grassland. Restoring a playa therefore requires: 1) funding the sediment removal; and, 2) compensating landowners for converting surrounding cropland to grasses. We estimate the value of playa improvement by evaluating data acquired through a double-bounded, referendum format, contingent valuation survey. We find that the mean willingness to pay (WTP) is positive and represents a sufficient social valuation to support playa restoration efforts.

Keywords: Playas, restoration, willingness to pay, contingent valuation

Introduction

The Southern High Plains of Texas is heavily dependent on the Ogallala Aquifer for irrigation. Intensive crop production has caused the saturated thickness of the Ogallala to diminish over time. Playa wetlands provide aquifer recharge and could be a sustainable way of increasing biodiversity and by extending the life of the Ogallala. Playas are small wetlands, averaging 14 acres in area, which periodically fill with rainwater and evaporate, and are not connected to any other body of surface water. On the Texas High Plains, the roughly 17,000 existing playas are a source of recharge for the Ogallala aquifer and the greatest concentration of biodiversity.

However, when land surrounding playas is farmed intensively, sediment carried by rainfall and irrigation fills the playa floor and inhibits the ability of a playa to recharge the aquifer and to provide habitat for native plants and animals. Playas that are surrounded by grassland seep water towards the aquifer four times faster than playas surrounded by cropland. Currently, only 5% of playas in the region function naturally. Johnson et al. (2012) used GIS to evaluate the physical loss and modifications of playas due to anthropogenic impacts, estimate a rate of playa loss, predict future playa loss, and to estimate the remaining number of playas in the southern Great Plains. They found 38.5% of playas have been lost from 1970 to 2008. Governmental agencies have offered programs through the Farm Bill to support the conversion and maintenance of wetlands through programs such as the Wetland Reserve Program and the Conservation Reserve Program.

Playas can be restored, however, by removing sediment and converting a 50-yard buffer around each playa to grassland. Restoring a playa therefore requires: 1) funding the sediment removal; and, 2) compensating landowners for converting surrounding cropland to grasses. It is estimated that the sediment removal would cost approximately $1,800 per acre of playa, on average.[1] Additionally, there is an opportunity cost involved in removing the playa and surrounding buffer from agricultural production.

Several studies have been performed that look at the impact of playa wetlands in the High Plains of Texas. Willis (2008) uses a simulation approach to estimate the cost of implementing land management practices to increase playa volume and reduce sedimentation in the SHP. He found that buffer strips can earn the same rental rate as CRP ($40/ac) for a cotton producer receiving government support payments with a Pullman Soil.

Jones, Amosson, and Warminski (2010) assess the economic impact of three government programs on playa lake restoration in the Southern High Plains. Programs include: Cp23A, Wetlands Reserve Program, and Wildlife Habitat Incentive Program. The CP23A program is an alternative to dryland farming or cash renting playa acres with an income of $22/ac. For dryland production, this could be better than farming. The Wetlands Reserve Program was established in 1990 to restore and maintain wetlands offered to private property owners as three types of cost-sharing options that include a permanent easement, 30 year easement, or a restoration cost-share agreement. The permanent easement places a deed restriction on the property and USDA pays 100% of easement and 100% restoration, the 30 year easement is a 30 year deed restriction with easement payments and 75% of a permanent easement and the restoration cost share agreement has no deed restrictions with USDA paying 75% of restoration costs. A sensitivity analysis for the WRP ten-year cost share shows revenues need to overcome losses from not farming of $23-$34 for various levels of restoration costs. The Wildlife Habitat Incentive Program requires implementing higher is more desirable at lower restoration costs and longer contract lengths.

Gelso, Fox, and Peterson (2008) used a CV approach to estimating the cost of permanent and temporary wetlands to producers in Kansas using wetland and farm characteristics, and producer attributes and attitudes. They found permanent wetlands impose greater costs than temporary wetlands and producers would pay less for cropland containing permanent wetlands as opposed to seasonal wetlands. The estimated cost of having a wetland area can be as high as 56% of farmland rent. Among the seasonal wetlands, varying the hydration between 40% to 80% doesn't change the cost. Has a negative correlation between returns on wetland and upland areas.

Johnson et al. (2011) use a Generalized Linear Mixed Model they found mean annual rainfall, playa size, grassland in the wetland, and the previous year's rainfall are the best predictors of a playa being inundated in January. They found that 52% of playas in the THP would be inundated in January in 1 out of 16 years, 18% of playas would be inundated once out of every 9-16 years, and a 30% chance of being inundated every ten years. Due to sedimentation, cropland watersheds diminish the ability of a wetland to provide aquifer recharge with probabilities of 0.1078 for playas with more than 50% grassland in the watershed and 0.0775 for playas with more than 50% cropland in the watershed.

Given an estimated cost of $1,800 per acre for sediment removal, and between $1,400 and $2,400 to enroll an acre in an existing playa conservation program,[2] it is important to ascertain the societal benefit

[1] Personal correspondence with D.A. Haukos.
[2] Playa Lakes Joint Venture slides. Retrieved January 3, 2015 from http://www.kwo.org/Ogallala/Governors_Conference/2014

of such an endeavor. There is assumed to be little or no private benefit to the landowner, given that Johnson (2012) finds that much of the human modification of playas has resulted from agricultural production. Therefore, this study aims to estimate the household WTP for the restoration of playa lakes. If policy is being implemented in order to improve the health of the playa lakes system we should have an understanding of the value that society places on the restoration.

Data and Methods

The data for this study was collected through a contingent valuation (CV) survey. Potential participants were recruited by Qualtrics Panels, LLC from a set of predefined zip codes in west Texas and north Texas. The geographic region was bounded by the Texas-New Mexico border to the west, the Texas-Oklahoma border to the north, the eastern edge of the Dallas-Ft. Worth metropolitan area to the east, and 100 miles south of Interstate 20 to the south. This area represents the most likely potential users of the groundwater resource of the Ogallala aquifer. The survey was approved by the Texas Tech University Human Research Protection Program.

Survey respondents were given background information about the Ogallala aquifer and asked a number of demographic questions including age, gender, education, income, and number of children. In addition to the basic demographic questions, respondents were asked to respond to a number of other questions which might impact their valuation of playa restoration. First, using the 5-digit zip code, the respondent was categorized as either living in a rural location (county population less than 10,000) or non-rural. Second, participants were asked if they believed that their children would choose to reside in Texas into the future. Third, binary response questions were presented which queried whether the household's income was dependent upon agriculture or groundwater resources. Respondents were also asked if their drinking water came from groundwater resources and if they were familiar with the Ogallala aquifer prior to their participation in the survey.

A final set of background data were collected with intent of controlling for pro-environmental attitudes of respondents. Kotchen and Reiling (2000) utilize the New Ecological Paradigm scale (NEP) to demonstrate that mean WTP estimates obtained through nonuse CV surveys are positively correlated with pro-environmental attitudes. The NEP consists of 15 statements about the environment, with Lickert scale responses (Dunlap et al. 1992).

Following the demographic questions, participants were presented with background information about playa lakes. This information included the location of playa lakes and the hydrologic functions of the playas, and a brief statement about the current state of the playa lakes system. Additional information was provided about the work that would need to be done to restore a playa lake to an appropriately functioning level. One half of the participants were given additional brief information indicating that the playa lakes also provide ecosystem services in the form of a concentrated biodiversity on the Great Plains.

The use of a referendum question for CV is a recommended approach by Arrow et al. (1993). Participants were asked to suppose that a referendum appeared on the next state ballot that asked for a one-time tax that would be used to restore 1,000 playas to proper function. Each respondent was presented with one of four sets of values for the tax, such that each set was seen by one-fourth of respondents. If the respondent answered yes to the first value, they were presented with a value twice as much as the first and were asked to vote yes or no on the new value. If they answered no to the first value, they were asked if they would be willing to pay any positive amount. An example of the referendum question is provided below:

> Suppose the following appears as a referendum on the next state ballot. Please vote YES or NO.
>
> Would you support a one-time increase in your household taxes, in the amount of $x, to restore 1,000 playas (approximately 22 square miles of playa area) to proper function?

The dollar amount combinations that were presented were as follows: ($1, $2), ($2, $4), ($5, $10), and ($10, $20). These values were chosen in order to provide a wide range around the know use values for groundwater in the region. We fix a lower bound value of zero for all respondents, as a negative WTP for restoration of the playa lakes doesn't make economic sense. We set the upper bound at $30, which is one and one-half times the maximum value with which any respondent was presented.

Of the 326 original observations, 11 were removed from the sample because their "no" votes constituted a protest to the idea of taxation in general. The data was then analyzed using PROC LIFEREG in SAS v9.4. This estimation procedure was chosen because the parameter estimates on all independent variables represent the marginal effect that any given variable has on the mean WTP.

Results

We first present, in Table 1, the percentage of respondents answering Yes-Yes, Yes-No, and No-No to four different dollar combinations that they might have been presented with. Consistent with economic theory the percentage of YES responses decreases as the price is increasing. Interestingly, however, there isn't much variation in the probability of a YES response for referendum amounts under $10.

Table 1: Percentage of Responses to Referendum Values

	Answers to Referendum Questions		
Values	Yes - Yes	Yes - No	No - No
$1 - $2	91.36%	1.23%	7.41%
$2 - $4	91.76%	0.00%	8.24%
$5 - $10	90.36%	4.82%	4.82%
$10 - $20	71.43%	10.39%	18.18%

The results from the estimation are presented in Table 2. As mentioned in the prior section, the parameter estimates represent marginal effects on the mean WTP. For example, all else equal, an NEP score that was one unit greater would increase the mean WTP by $0.18.

Table 2: Proc LIFEREG Estimation Results for Willingness To Pay for Restoration of 1,000 Playa Lakes

Variable	Parameter Estimate	Standard Error	p-Value
NEP Scale	0.18	0.048	< 0.001
Personal v. Business	-0.51	0.412	0.218
Rural	3.72	2.002	0.063
Age	0.62	0.603	0.303
Male	-2.54	1.247	0.041
Stay in State	0.12	2.743	0.966
Child	0.52	1.882	0.784
Children_Stay	2.42	1.561	0.120
Education	0.81	0.614	0.187
Income	1.26	0.585	0.031
Agriculture	1.39	2.391	0.562
Groundwater	0.18	1.903	0.924
Drinking	-1.67	1.236	0.177
Familiar	-0.44	1.289	0.731
Ecosystem Services	-1.62	1.120	0.147

Recalling that the NEP scale was included in order to control for the impact that pro-environmental attitudes have on nonuse CV estimates of WTP, the statistical significance of that variable in our model should be expected. While statistically significant at the 1% level, the magnitude appears to be quite small. However, an individual score on the NEP scale may range between 15 and 75; so the difference between a 45 (a fairly moderate pro-environment response) and a 60 (fairly solidly pro-environment) would account for an estimated difference in WTP of 15*$0.18, or $2.70 for a household.

The variable *Rural* is a dummy variable that takes the value of one if the respondent resides in a county with population of less than 10,000 people and a value of zero otherwise. The estimation results indicate that households in rural settings have a mean WTP that is $3.72 higher than their non-rural counterparts. This result is reasonable, given that the playa lakes are likely a feature that rural inhabitants in the region are familiar with. However, we would hypothesize that rural households would be more likely to have concerns about a program which would likely take land out of agricultural production. This is a result that bears further evaluation.

There are two remaining variables of interest. The first is the dummy variable *Male*, which indicates that female respondents have a mean WTP that is $2.54 greater than their male counterparts. Second, there is a positive and statistically significant relationship between household income and mean WTP. *Income* is a categorical variable because the survey asked about household income in four ranges (<$30k, $30k-$60k, $60k-$90k, and >$90k). Therefore, we are unable to interpret the result as a direct relationship between household incomes and mean WTP.

Given the estimation results, we can use the mean values of each variable from the data to estimate a mean household WTP for restoring 1,000 playa lakes of $18.21. If we multiply that value by the estimated number of households in the study area (3.27 million), divide by the 22 square miles of playas that would be restored, then divide that by 640 (the number of acres in a square mile), the estimated mean WTP for a restored acre of playa lakes is $4,228.

Conclusions

This research was aimed at evaluating the potential social benefit of playa lake restoration on the High Plains of Texas. These ephemeral wetlands serve important hydrologic and ecosystem functions for the region. Anthropogenic modifications to playa lakes have left most of them either not functioning or functioning poorly. Restoration of the playa lakes could serve to increase recharge to the Ogallala aquifer and provide improved stability for the biodiversity of the plains.

We estimate a mean WTP to restore an acre of playa lake at around $4,200. If the cost of sediment removal is estimated to be approximately $1,800 per acre, and current playa conservation programs are contracted at between $1,400 and $2,400 per acre, that puts the total cost of restoration/conservation right at the estimated social value.

Additional research should investigate possible use values for playa lakes, such as hunting and birdwatching. If such activities place a sufficiently large value on the health of the playa lake ecosystem, perhaps there would be a possibility for the development of a conservation credit market for these ephemeral wetlands.

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