Article

Perceived Economic Value of Ecosystem Services in the US Rio Grande Basin

Weiwei Wang ^{1,*}, Jianhong E. Mu ² and Jadwiga R. Ziolkowska ³

¹ School of Business, Nanjing University of Information Science and Technology, Nanjing 210044, China

² Environment and Planning Program, Texas A&M Transportation Institute, Texas A&M University System, Austin, TX 78752, USA; j-mu@tti.tamu.edu

³ Department of Geography and Environmental Sustainability, University of Oklahoma, Norman, OK 73019, USA; jziolkowska@ou.edu

* Correspondence: weiwei.wang23@outlook.com

Abstract: In recent decades, the US Rio Grande Basin has experienced serious ecosystem degradation as a result of recurring severe droughts and a growing population. Monetary valuation of ecosystem services is essential for encouraging conservation where natural resources such as freshwater are limited. Research in this field is still very limited, and economic estimations of ecosystem services in the US Rio Grande Basin have not been undertaken extensively. This study adds to the existing contemporary literature by means of the willingness-to-pay evaluation. We found the mean household willingness to pay of total ecosystem services across the Rio Grande Basin to amount to USD 62/year, and the average perceived economic value was estimated to be USD 26.2, USD 19.7, USD 8.1, and USD 7.1 yearly for conservation of habitat for wildlife, provision of freshwater supplies, recreational activities, and cultural heritage, respectively. The income and perceptions about the importance of various ecosystem services in the Rio Grande Basin were among the main determinants of respondents' assessments. The findings provide an appropriate foundation for incorporating perceived economic value into watershed management and conservation.

Keywords: willingness-to-pay; contingent valuation; ecosystem services; economic evaluation; Rio Grande

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1. Introduction

According to the Millennium Ecosystem Assessment [1], ecosystem services are defined as the benefits to human well-being obtained from ecosystems (biotic and abiotic elements of the environment) that serve both local communities and natural environments. Healthy freshwater ecosystems provide benefits and services that are the foundation for human and social development. Quantifying the value associated with watershed ecosystem services is useful to support environmental policy decisions and to promote sustainable watershed management and conservation [2–6].

Several economic valuation methods have been developed to assess the value of changes in ecosystem services. Non-market valuation methods are useful in cases when direct markets for ecosystem goods and services do not exist and direct market prices are missing. More specifically, the contingent valuation method (CVM) has been widely used to measure people's willingness-to-pay (WTP) for nonmarket goods or services [2,7–10]. CVM involves the use of sample surveys (questionnaires) to elicit respondents' statement of their WTP for particular changes in the provision of ecosystem services. This approach is known to have some common biases arising from strategic behavior, the survey design, the payment instrument, and the bid-amount starting point [11]. Nevertheless, it is argued that CVM should be a suitable and useful tool in detecting and communicating changes in ecosystem-services provision, thus increasing the visibility of nature in valuation [5,12–14]. Another issue with CVM is that many interviewees provide protest responses, which may

result in a sample-selection problem in the estimation of WTP [15]. In order to correct the protest-response issue, some studies chose to remove the protest responses [16,17]. However, this is only correct if protest responses are randomly distributed across the protest–non-protest divide [18]. Overlooking the effect of protest responses would cause an upward bias of the final WTP estimation, whereas treating all protest votes as true-zero bidders and including them in model estimation would cause a downward bias in WTP [19]. To test and solve for the potential sample-selection bias, the Heckman sample selection two-step model is proposed [20]. This approach has been adopted in a number of studies to correct the possible estimation bias of WTP [2,21–23].

The Rio Grande Basin's water resources and ecosystems are seriously threatened by drought and a fast-growing population [24]. Stakeholders in the Rio Grande Basin are strongly interested in solutions to address the widening gap between the declining water supplies and increasing water demands from different economic sectors and users. Although several water-management and conservation schemes have been implemented in the Rio Grande Basin (e.g., more-efficient water delivery systems, water right conversion from agriculture to urban uses, and desalination investments), none of these solutions provide a single answer to the complex water issues in the basin.

This study focused on the economic evaluation that could help incentivize residents of the Rio Grande Basin to conserve water resources and maintain ecosystem services for different applications. To address this issue, the willingness-to-pay (WTP) method was applied and Heckman's two-stage model was used for the WTP analysis. The main purpose of this research was to determine a monetary value of ecosystem services provided by the Rio Grande. Moreover, this explorative and empirical study provides insights about human perceptions regarding the importance of the river basin and related ecosystem services in all three US Rio Grande states: Colorado, New Mexico, and Texas. While research is available about some specific ecosystem services of the Rio Grande basin, or of different river sections [25–27], to our best knowledge, there is no study of perceived economic value for the US basin so far. This study offers a valuable economic assessment of ecosystem services by means of one holistic methodological approach across the entire US Rio Grande Basin. The results of this research can help guide decisions regarding water-resource conservation and management, subsequently enhancing the resilience of the river watershed to climate changes and extreme weather events [28–31].

2. Study Area

The Rio Grande Basin is located in the southwestern United States and spans over 870,000 km² across three US states (Colorado, New Mexico, and Texas) and Mexico [32]. This study was conducted in the river basin within the US only (Figure 1). The study area represents a vibrant and growing region with multiple socio-economic and environmental issues related to sustainable and efficient water use and management. For example, the population in Colorado, New Mexico, and Texas almost doubled from 19.7 million to 33.3 million during 1982–2012, which raised demands for natural resources, especially freshwater. Moreover, this region experienced significant economic growth. According to the US Bureau of Economic Analysis, from 1997 to 2012, the per capita real gross domestic product (GDP) in these three states increased by 14.4, 10.2, and 22.3%, respectively. As a result of the economic development and population growth occurring simultaneously, withdrawals of groundwater and surface water across the Rio Grande Basin increased from 19 billion gallons per day (BGD) in 1985 to 39 BGD in 2010 [33]. With reduced streamflow and recharge rates, water availability and supply for different uses in the Rio Grande Basin commenced to pose an urgent issue affecting not only human well-being but also the provision of ecosystem services.

Figure 1. Location of the Rio Grande Basin. Dark gray shading shows the study area that is located within the US.

3. Methods

In our hypothesis, we expect personal preferences and social-economic characteristics to affect the people's WTP for conserving the ecosystem services of the Rio Grande Basin. In order to test the hypothesis, contingent valuation surveys were conducted in the first step followed by a Heckman sample-selection model to determine the economic value of water ecosystem services stemming from the US Rio Grande, unveiling the relationship between WTP and personal characteristics.

3.1. Survey Design

An online survey was designed with the Qualtrics software at the University of Oklahoma and approved by the University of Oklahoma-Norman Campus Institutional Review Board. During February and March 2017, the survey was validated with a pre-test run among the United States Geological Survey (USGS) project participants, collaborators, and other university scholars and students working on water-related issues. The final questionnaires were distributed by email to 350 stakeholders in the Rio Grande Basin from the beginning of May to the end of September in 2017. The participants were randomly drawn from USGS database of the residents and project collaborators in the respective basin locations.

The survey respondents include stakeholders working in different functions in the Rio Grande Basin, residents of the basin, and tourists visiting the river basin. These three distinct groups were selected through the process of random sampling and a snow-balling method, with the aim to address the potential variability of responses.

The web-based survey contained 32 questions in three parts:

Part 1: Inquiring about respondents' perceptions regarding the status and issues of ecosystem service provision in the Rio Grande Basin;

Part 2: Inquiring about respondents' willingness-to-pay and the US dollar (\$) value they would be willing to spend on maintaining the analyzed ecosystem services in the Rio Grande Basin (a standard WTP question format was used due to its proven robustness in the literature);

Part 3: Inquiring respondents about their environmental behaviors (i.e., if the respondent was a member of either an environmental or social association) and socio-demographic characteristics (i.e., place of residence, education, age, income, etc.).

Four key ecosystem services (freshwater supplies, cultural heritage, habitat for wildlife, and recreational activities) were selected in this study based on the following criteria: representation of the different service categories of provisioning, supporting, regulating and cultural services, and the inclusion of water-related services. The freshwater supplies service directly refers to the natural river capacity (river flows) needed to sustain water provisions from the Rio Grande to communities relying on the river water for a multitude of uses. The service of habitat for wildlife (i.e., products and services derived from hunting, fishing, and plant collecting) is referred to as direct supporting and regulating services in the river basin. Cultural heritage and recreational activities (i.e., tourism activities like fishing and rafting) describe classic examples of cultural ecosystem services.

In Part 1, respondents were asked to choose from four ecosystem services most important to them and to rank them using a five-point Likert scale from one (least important) to five (most important). An ordinal measure of the social importance of each service was created from this part.

In the second part of the survey, respondents were then asked if they would be willing to pay through an annual donation to protect the Rio Grande Basin to continue providing benefits to the society. An open-ended contingent valuation format was used for eliciting respondent's WTP for maintaining ecosystem services. If the response was affirmative with an indicated maximum WTP, the authors then ascertained that the respondent would be willing to pay. If the response was negative, the follow-up question, why the respondents would not want to make a monetary contribution, was asked to distinguish protest responses from the real zero values.

3.2. Model Specification

Based on the survey outcomes, the Heckman two-step model was applied to the WTP analysis. The advantage of the Heckman approach is that it controls for the sample selection issue by the simultaneous estimation of two processes: selection and outcome. The first step entails the estimation of the respondent's decision to pay or not to pay through a probit regression, and the second step models the WTP for non-protesters through ordinary least squares (OLS).

Technically, the linear probit model determines the respondents' decision (Z) on whether to support the preservation of ecosystem services by:

$$Z_i = \begin{cases} 1 & \text{if } Z_i^* > 0 \\ 0 & \text{if } Z_i^* \leq 0 \end{cases} \quad \text{and} \quad Z_i^* = \alpha'W_i + u_i \quad (1)$$

where: Z_i^* is a latent participation variable that takes the value of 1 if the respondent would like to support the provision of ecosystem services, or 0 otherwise; W is a vector of household characteristics; and α is a vector of parameters to be estimated with the model.

Based on the respondents' general decision about preservation of ecosystem services (Equation (1)), the stated amount of willingness-to-pay (in \$ value) was estimated using an OLS regression model:

$$y_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \text{ and } Z_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \quad \text{and} \quad y_i^* = \beta'X_i + v_i \quad (2)$$

where: y_i is the observed answer to the WTP valuation question about the \$ value the respondent is willing to pay for preserving ecosystem services; X is a vector of individual characteristics; and β is a vector of parameters to be estimated with this model.

In both equations, the variables represented by the W and X parameters can be the same or different, thus representing the same or different characteristics of the respondents depending on the variable selection. The Least Absolute Shrinkage and Selection Operator (LASSO) method was applied in the first place for the two-step model to select the most-relevant variables conditional on a small sample size. LASSO is a regression analysis method that performs both the variable selection and regularization in order to enhance the prediction accuracy and interpretability of the statistical model it produces [34,35]. Using the LASSO method, a robust subset of covariates rather than all variables was selected to be used in the final two-step model [36]. As a result of this methodological proceeding, each equation can be characterized by a different set of variables, which provides a broader range of outcomes describing the variability of ecosystem services and their randomness in a more accurate and comprehensive way.

4. Results

4.1. Descriptive Statistics

Among the 350 surveys sent, 106 surveys had been returned with valid information; thus, the response rate was about 30.3%. Of the respondents, 67% were residents of the basin, 21.7% were stakeholders working in the basin, and 11.3% were tourists visiting the basin. The socio-economic characteristics of the respondents in the survey sample were compared to the 2010 US Census data of the three states. Most characteristics in the survey had matching or closely similar values to the census data (Table 1). In the survey sample, 64.2% were male, 62.9% were white, and 100% held a college or higher degree. The median annual household income ranged between USD 60,000 and USD 80,000, and the average household size was 2.7 persons. As respondents were mostly homeowners or professionals in this region, our sample might over-represent the relatively aged and educated individuals, which should be kept in mind when applying these results to the extent of the entire Rio Grande Basin or associated states. A reliability test was conducted to confirm the reliability of the respondent's attitude variables in terms of Cronbach's alpha value. The Cronbach's alpha score for the subconstructs ranged from 0.604 to 0.842, indicating that the survey is more reliable.

Table 1. Comparison of 2010 US Census data and survey sample data regarding socio-economic characteristics.

Variable	US Census			Survey
	Colorado	New Mexico	Texas	Mean
Median age (years)	36.8	37.7	34.7	49.3
Female (%)	49.5	50.5	50.4	35.8
Race/ethnicity (%)				
White	68.2	37.4	41.9	62.9
Hispanic	21.5	48.8	39.4	28.9
Black or African American	3.9	1.8	11.8	1.0
Asian	3.1	1.3	4.8	0
American Indian or Alaska Native	0.6	8.8	0.3	2.1
Others	2.7	1.9	1.8	5.1
Education attainment * (%)				
High school graduate or lower	29.7	40.5	41.4	0
College or higher	70.3	59.5	58.6	100
Median household income (\$)	60,629	44,964	53,207	60,000–80,000
Persons per household (person)	2.6	2.7	2.8	2.7

* Education data are from a population 25 years and over.

Table 2 provides definition and summary statistics for the variables used in the model. Overall, 75.5% of the sample responded “yes” to the CVM question with a stated value. The remaining 24.5% respondents who were not willing to pay gave their reasons in the follow-up questions (Table 3). We assumed that some of the reasons provided by respondents not

willing to pay for maintaining ecosystem services were considered as protest responses such as “The government or polluters should pay,” “Lack of sufficient information to decide,” and “Environment associations are not effective.” Such responders represented 73.1% of the “no” responders and 17.9% of total responders.

Table 2. Descriptions and summary statistics of variables used in economic valuation analyses.

Variables	Description	Median	Mean (std. dev.)	Min	Max
Education level	Highest level of academic education completed (no schooling completed (1) to doctorate degree (9))	7	6.99 (1.43)	3	9
Age	Respondent's age	50	49.98 (12.98)	19	87
Income level	Annual household income (<\$20,000 (1) to >\$80,000 (5))	4	4.03 (1.28)	1	5
Female	If the respondent is female (=1 yes; 0 otherwise)	1	0.36 (0.48)	0	1
Household size	Number of household members	2	2.69 (1.10)	1	6
Hispanic	If the respondent is Hispanic (=1 yes; 0 otherwise)	0	0.26 (0.44)	0	1
Resident	If the respondent lives in the basin (1 = yes; 0 otherwise)	1	0.67 (0.47)	0	1
Grandparent	If the respondent's grandparents come from the basin (1 = yes; 0 otherwise)	0	0.34 (0.48)	0	1
Association	If the respondent is a member in any association, society, or other organization (1 = yes; 0 otherwise)	1	0.69 (0.47)	0	1
Community	If the respondent participates in any community activities (1 = yes; 0 otherwise)	1	0.82 (0.39)	0	1
Drought	If the respondent realizes negative impacts of drought on water flow (1 = yes; 0 otherwise)	1	0.67 (0.47)	0	1
Upstream	If the respondent realizes negative impacts of upstream water use on water flow (1 = yes; 0 otherwise)	1	0.61 (0.49)	0	1
Ecosystem perception (fresh water)	Perception of the importance of freshwater supplies in the basin (least important (1) to most important (5))	5	4.74 (0.82)	1	5
Ecosystem perception (culture heritage)	Perception of the importance of cultural heritage in the basin (least important (1) to most important (5))	4	3.58 (1.08)	1	5
Ecosystem perception (habitat for wildlife)	Perception of the importance of habitat for wildlife in the basin (least important (1) to most important (5))	4	4.12 (0.90)	1	5
Ecosystem perception (recreation)	Perception of the importance of recreational activities in the basin (least important (1) to most important (5))	4	3.47 (1.09)	1	5
Time	Duration (in minutes) of finishing the online survey	1.69	18.96 (130.19)	1.52	1306.17
Location_Lat	Latitude of respondent's location	35.07	33.71 (5.75)	18.87	44.24
Location_Lon	Longitude of respondent's location	−105.32	−104.09 (8.77)	−155.14	−73.99

Table 3. Numbers and reasons for respondents who were not willing to pay.

Reasons for Non-WTP	Number of Responders	% in Non-WTP Responders	% in Overall Sample	Responder Type
Government/polluters should pay	9	34.6%	8.5%	Protest
Lack of sufficient information/details to decide	5	19.2%	4.7%	Protest
Environment associations are not effective/trustable	5	19.2%	4.7%	Protest
I am not a resident of the basin	3	11.5%	2.8%	True zero
I cannot afford it	2	7.7%	1.9%	True zero
Other	2	7.7%	1.9%	True zero

4.2. Perceptions about Water Issues and Ecosystem Services in the US Rio Grande Basin

Around 67% of survey respondents were residents in the Rio Grande Basin, and 34% had parents or grandparents living in this region. Those numbers could suggest that many respondents have high awareness of the water issues and changes in ecosystem services in the basin and therefore a good understanding of the necessity to conserve water resources. Figure 2 shows that most respondents identified water availability as the most-urgent issue in the basin region (rank five on the one to five Likert scale), followed by ecosystem conservation necessity (53.8% respondents) and the water-quality issue (50.9% respondents). Water-rights issues and recreational activities were ranked by most respondents as the least-relevant issues in the river basin.

Figure 2. Percentage of respondents' perceptions about the importance of various water issues in the Rio Grande Basin (N = 106). Importance level increases from 1 to 5; 1 represents least important, and 5 represents most important.

Different perceptions about water issues were found to directly translate to different preferences regarding the provision of ecosystem services. While most respondents acknowledged the provision of ecosystem services as relevant, they mentioned to have noticed a decrease in those services in the past 10 years. Among the four analyzed ecosystem services (freshwater supplies, habitat for wildlife, cultural heritage, and recreational activities), 84% of respondents ranked “freshwater supplies” as the most important concern and identified it as the most decreased ecosystem service in the last decade. Decreases in “habitat for wildlife,” “cultural heritage,” and “recreational activities” were classified as the most relevant/urgent by 54.7, 22.6, and 19.8% of the respondents, respectively. The respondents’ perceptions about the importance of freshwater supplies and conservation of habitat for wildlife as the most-relevant ecosystem services aligned with their assessment about the most-drastic decrease rates. However, the assessment of decreasing recreational activities (41 respondents) in the past decade outranked that of cultural heritage (35 respondents) (Figures 3 and 4). This diverging assessment can be explained by the intangibility of “cultural heritage” as an ecosystem service and changes to its provision. While it is relatively uncomplicated to detect changes in visitation numbers based merely on observational perceptions (without scientific evaluations), it is challenging to detect and measure a change about “cultural heritage” provided by the Basin. However, the relatively high number of respondents emphasizing changes in this particular ecosystem service underscores solid knowledge of the respondents about the river basin and the broader picture of water-related issues, as described above.

Figure 3. Percentage of respondents’ perceptions about the importance of four ecosystem service provisions in the Rio Grande Basin (N = 106). Importance level increases from 1 to 5; 1 represents least important, and 5 represents most important.

Figure 4. Percentage of respondents' perceptions about the benefits provided by the Rio Grande Basin over the last 10 years (N = 106).

Tracking back the reasons of changes in ecosystem service provision in the basin, a positive association was found between changes in water flows and the provision of ecosystem services, which indicates that increased water flows would result in a higher provision of ecosystem services (Figure 5). However, the plurality of the respondents believed that drought and upstream water use decreased water flow in the basin over the past 10 years (Figure 6).

Figure 5. Percentage of respondents' perceptions about the impact of water flows on the provision of ecosystem services in the Rio Grande Basin (N = 106); 1 represents the most negative, and 5 represents the most positive.

Figure 6. Percentage of respondents' perceptions about the effect of upstream water use and drought on stream flows over the past 10 years in the Rio Grande Basin (N = 106).

4.3. Factors Affecting Willingness-to-Pay in the Rio Grande Basin

The factors affecting the willingness-to-pay for maintaining ecosystem services in the basin were determined with the Heckman sample selection model (Table 4). The inverse Mills ratio is insignificant and implies no serious concerns with sample-selection bias.

Regarding the results of the selection-model estimation, the outcomes show that several factors affect respondents' decisions on whether to support maintenance and provision of ecosystem services. Generally, respondents with higher education levels, respondents of Hispanic origin, residents living in the Rio Grande Basin, and respondents with parents/grandparents living outside of the basin region are more inclined to support the maintenance and provision of ecosystem services, thus indicating a higher frequency and probability of willingness-to-pay in general terms.

Accordingly, with an increase in respondents' education level (from each given level of education to a next higher level of education as specified in the survey), the probability of the general decision about contributing financially to the maintenance of ecosystem services would increase by 54.5%. Hispanic ethnicity of the respondents would indicate a higher probability of their positive decision to support the maintenance of ecosystem services financially, compared to other ethnicities. Similarly, residents of the basin were found to have a higher probability for willingness to pay for ecosystem service maintenance. However, if the respondents' parents/ grandparents are residents in the basin, the probability of the respondents' decision to contribute to ecosystem service maintenance financially would decrease.

Table 4. Estimates from the Heckman two-step model (N = 106).

Variables	Selection Equation		Outcome Equation			
	Zi	Total WTP	Freshwater Supplies	Culture Heritage	Habitat for Wildlife	Recreational Activities
Education level (low (1) to high (9))	0.5445 *** (0.2049)	−0.0747 (0.1521)	0.5451 (1.3794)	0.6189 (0.7752)	0.7180 (0.9777)	
Age	−0.0302 (0.0184)	−0.0106 (0.0150)	−0.1176 (0.1262)	−0.1721 ** (0.0889)	−0.1482 * (0.0836)	−0.1742 ** (0.0791)
Income level (low (1) to high (5))		0.4359 *** (0.1165)		0.4685 (0.8195)		
whether is female	−0.3705 (0.4640)	0.0250 (0.2747)	−2.3930 (2.4866)		−1.2943 (1.7501)	
Household size	0.2296 (0.1890)	−0.1308 (0.1272)		0.2823 (0.8787)	−0.3456 (0.8201)	
Whether is Hispanic	1.8694 *** (0.6179)	0.4801 (0.5375)	4.3299 (4.1547)		−0.1461 (3.2224)	
Whether is resident	1.3458 *** (0.4706)	0.4592 *** (0.1182)	1.9269 *** (0.4070)		2.1885 * (1.3067)	
Whether grandparents are residents	−1.7290 *** (0.4539)	−0.1894 (0.5584)	−9.1419 ** (4.5451)		−1.9021 (3.4607)	
Whether is association member	0.3480 (0.4772)	0.1197 (0.2779)	2.5475 (2.5723)			
Whether participating in community activities	0.2896 (0.5710)	0.0999 (0.3913)		3.2655 (2.6001)	2.4050 (2.3938)	3.2468 (2.7914)
Whether realizing negative impacts of drought on water flow	0.2069 (0.3833)	0.2950 (0.2431)			2.3641 (1.7562)	
Whether realizing negative impacts of upstream water use on water flow					1.2158 (1.7785)	
Importance of ecosystem services			2.4575 ** (1.0165)	3.0064 *** (0.7511)	2.1231 *** (0.6786)	2.7834 *** (0.8038)
Time to finishing the online survey	−0.0016 (0.0022)	−0.0016 (0.0028)	0.0104 (0.0258)		−0.0078 (0.0172)	
Respondents’ location latitude	0.0841 * (0.0429)	−0.0326 (0.0269)	0.0579 (0.2506)		0.2208 (0.1739)	0.0946 (0.1727)
Respondents’ location longitude	−0.0217 (0.0236)	0.0047 (0.0127)		−0.0935 (0.0938)	−0.0833 (0.0822)	−0.1083 (0.1005)
Constant	−8.2704 ** (3.4854)	2.0182 *** (0.6507)	−6.6140 ** (3.1066)	−26.0853 (18.0388)	−16.7574 (13.3268)	−24.3879 (20.1037)
Mills lambda		0.4915 (1.0091)	9.1608 (7.4524)	−1.6139 (3.6294)	5.8926 (6.0775)	3.6748 (3.8510)

Note: standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$ and *** $p < 0.01$.

As to the results of the second model estimation (outcome equation), several factors were found to affect the economic value assigned to the respective ecosystem services, although considerable differences were detected in the estimates for the different types of the ecosystem services. The following statements can be derived from the statistical analyses of the respective ecosystem services groups:

(1) Regarding the WTP for all ecosystem services combined, the income level and residence of respondents in the region are positively related to the amount of money the respondents would be willing to pay. Accordingly, the higher income level would result in the higher WTP. People living in the basin area were more likely to favor a higher level of financial support for ecosystem services.

(2) In regard to the payments for freshwater supplies, whether the respondent is a resident has a positive impact on the mean WTP, whereas having parents or grandparents living in the basin region has opposite effects.

(3) In regard to cultural heritage, older respondents indicated a lower WTP for maintenance of this ecosystem service. The respondents who gave more on the importance of cultural heritage provided by the basin were more willing to increase their WTP for maintaining this service.

(4) In regard to habitat for wildlife, the model results show that younger respondents and residents of the basin region would be willing to pay more for conserving habitat for wildlife than the rest of the respondents.

(5) In regard to maintaining recreational activities, the same two variables were found to be statistically significant as in the model of culture heritage, which could indicate that recreational activities are viewed similarly as the benefits provided by culture heritage. Younger people and people who have knowledge about the importance of recreational activities were more likely to donate more money.

4.4. Willingness-to-Pay for Preserving Ecosystem Services in the Rio Grande Basin

The WTP for ecosystem service provided by the basin was found to average at USD 62 as an annual donation. Depending on the respondents' perceptions about the provision of ecosystem services, a wide variability in their willingness-to-pay for each type of the ecosystem services was found, ranging between USD 0 and 250 for the total of ecosystem services provided by the basin, with a median of USD 50/year (Figure 7). "Habitat for wildlife" received the highest mean WTP (USD 26.2/year) compared to the other three groups of ecosystem services. "Freshwater supplies" received the second-highest mean WTP (USD 19.7/year) in annual donations. These findings are consistent with the results presented in Figures 2–4, showing that the respondents would be willing to pay more for the river ecosystem services they find most relevant for the Rio Grande Basin, mostly affected by upstream water use and drought over the past decade.

Figure 7. Distributions of WTP value of total ecosystem service and WTP values across four types of ecosystem services in the Rio Grande Basin (N = 106).

Interestingly though, the WTP for conserving the habitat for wildlife was ranked higher than for freshwater supplies. It can be deduced that most respondents associate a donation as a valid support form mainly for cultural, regulating, or supporting ecosystem services rather than provisioning ecosystem services (like freshwater supplies) that humans rightly understand as one of the basic and essential rights to live. Additionally, since water is a common good, humans tend to anticipate a secured access to water without the necessity to pay additional fees towards water provision.

5. Discussion

Sustaining healthy freshwater ecosystems is a global challenge, especially with increasing population and climate change [37,38]. Deterioration of ecological services caused by human activities and changing climate has severely threatened the food safety, human health, and sustainable development of watersheds in the US and many other countries [7,26,38–40]. Ecosystem services that contribute directly to human well-being are increasingly being taken into consideration in decision-making processes and in international studies, treaties, and conventions [41–43]. Simply classifying services is insufficient for informing policy. Understanding the benefits and economic value that people get from ecosystems is essential for making water-management strategies and policy decisions. This study applied a contingent valuation method to identify social preferences and WTP for preserving watershed ecosystem services in the Rio Grande Basin.

Among the investigated ecosystem services in this study, freshwater supplies were recognized as the most important issue and the most-decreased ecosystem service in the last decade. This implies that most people prioritize services that directly affect human health and local economies such as drinking water, farming, and fishing. This perception is largely consistent with other residents' preferences revealed in global watershed studies [2,39,44]. Among the four analyzed ecosystem services, cultural heritage and recreational activities were judged the least important. These findings suggest that local managers and policy makers aiming at improving the watershed services should prioritize managing or allocating resources between competing demands and sustainable freshwater supplies.

The total economic value estimated for watershed services was found to average at USD 62 per household per year and an average of USD 12.4 per ecosystem service. Our mean WTP value was comparable to many other WTP exercises performed in the US and global watersheds. Weber and Stewart [26] estimated public values for river restoration on the Middle Rio Grande, New Mexico. Full restoration benefits were found at nearly USD 50 per household per year via contingent valuation. Castro et al. [2] targeted multiple stakeholders' social perception regarding various categories of ecosystem services in the Kiamichi River watershed in south central Oklahoma. The authors found the average WTP was USD 50 per household per year for all ecosystem services. Similarly, Lewis et al. [28] found that residents were willing to pay an average of USD 80 for the ecological services provided by riparian zones in an Ozark watershed located in Northwest Arkansas. The high variability of the WTP for the respective ecosystem services reflects the heterogeneous perspectives towards the value provided by the watershed. The revealed average amount of respondents' WTP for each ecosystem service was limited and even less than a meal at a restaurant. This suggests that people tend to anticipate the government's or community's initiatives in securing the freshwater provision and habitat for wildlife. The relatively low WTP for cultural services indicates the fact that the enjoyment of outdoor activities and appreciation of beautiful natural areas in the basin are not as crucial as freshwater demand to human beings.

The positive and significant determinants of WTP found in this study were respondents' income and residence in the Rio Grande area. Education level and watershed residence were also among factors that positively related to the probability of participating in economic-valuation exercises. These findings corroborate previous WTP literature on the importance of knowledge and direct experience in shaping respondents' WTP [45,46]. Intuitively, people with higher income were more responsive to providing financial support for maintaining ecosystem services. Watershed residents were also more willing to pay for preserving watershed services than nonresidents, which may be related to a greater concern and appreciation of the interdependence between environment and well-being. However, the parents/grandparents' residence in the basin was found to be negatively related to the WTP decision, which was also confirmed in other studies as well [2]. This counterintuitive outcome can be possibly explained by an implicit perception of the respondents that their parents and grandparents have already contributed to those ecosystem services in the past, thus their personal obligations could be lightened. Some studies [2,19] have also found

that other factors have significant impacts on WTP such as environmental-association members and a perception of government influence, but others, including this study, show the effects of these variables to be insignificant. From a water-management perspective, the findings suggest that appropriate education and community involvement with all levels' stakeholders are a useful tool in building commitment and willingness for change.

While economic incentives are not the panacea to solve the complex environmental issues, the estimates of perceived economic value delivered in this study can be used as an additional tool to other instruments. For example, for the decision to implement the water conservation project in the Rio Grande region, the aggregated value estimated from the public's WTP should be compared to the total cost as a means to explore the social desirability of the project. The integrative coupling of social-cultural valuation, economic assessment, and political instruments is important for sustaining ecosystem services [44].

6. Conclusions

In this study, a contingent-valuation methodology was applied to determine the willingness-to-pay and the corresponding economic value of ecosystem services provided by the Rio Grande Basin in three US states (Colorado, New Mexico, and Texas).

The average WTP for all analyzed ecosystem services amounted to USD 62/year, while most respondents assigned a higher economic value to the conservation of habitat for wildlife and the provision of freshwater supplies.

The results show that respondents with higher education levels, of Hispanic ethnicity, living in the Rio Grande Basin, and respondents with parents/grandparents living outside of the Rio Grande region are generally more inclined to support the maintenance and provision of ecosystem services. However, the economic value they assigned to each of the ecosystem services varies among the ecosystem-services groups and depends on several socio-economic characteristics of the survey respondents. The average WTP for fresh water supplies amounted to USD 19.7/year, USD 7.1/year for cultural heritage, USD 26.2/year for maintaining the habitat for wildlife, and USD 8.1/year for recreational activities.

Although this study is empirical and exploratory, the methodology can be recommended as a tool for interactive decision-making and round-table discussions among decision makers, stakeholders, water utilities, water-conservation offices, representatives from different economic sectors, and local communities. This would be especially valuable for the broader question at hand as the basin is split among three US states with different water jurisdictions, regulations, and laws, which makes water management quite challenging across the entire basin. Utilizing a holistic methodology, widely validated and acknowledged in scientific circles, could prove helpful with finding a common ground and a prospective direction for the design of water-conservation measures, both on the demand and the supply side. It could also be utilized to compare different water-conservation strategies in place and potential new technologies in terms of their economic efficiency, environmental sustainability, and social acceptance and equity.

More research is necessary to address the specific ecosystem-services issues of specific community or social groups. In addition, a county-, state-, and river-section-level differentiation of the WTP for the ecosystem services would be of particular interest to the research community and stakeholders. We leave these explorations to future work.

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