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## **Assessing Local Communities' Willingness to Pay for River Network Protection: A Contingent Valuation Study of Shanghai, China**

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**Abstract:** River networks have experienced serious degradation because of rapid urbanization and population growth in developing countries such as China, and the protection of these networks requires the integration of evaluation with ecology and economics. In this study, a structured questionnaire survey of local residents in Shanghai (China) was conducted in urban and suburban areas. The study examined residents' awareness of the value of the river network, sought their attitude toward the current status, and employed a logistic regression analysis based on the contingent valuation method (CVM) to calculate the total benefit and explain the socioeconomic factors influencing the residents' willingness to pay (WTP). The results suggested that residents in Shanghai had a high degree of recognition of river network value but a low degree of satisfaction with the government's actions and the current situation. The study also illustrated that the majority of respondents were willing to pay for river network protection. The mean WTP was 226.44 RMB per household per year. The number of years lived in Shanghai, the distance from the home to the nearest river, and the amount of the bid were important factors that influenced the respondents' WTP. Suggestions for comprehensive management were proposed for the use of policy makers in river network conservation.

**Keywords:** river network; attitude; contingent valuation; willingness to pay; Shanghai

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## 1. Introduction

A river network is a general feature of landscapes in Nature. It is formed by the river mainstreams and their tributaries in the river basin. The number and structure of river networks result from the interaction between the environment and human activity. River networks meet people's daily needs, improve water quality, protect against floods, and even furnish an extraordinary regional environmental and cultural landform [1]. In China, rapid urbanization and industrialization after the 1980s has reshaped the landscape in both urban and suburban areas, and consequently, the Chinese river network has suffered extensive destruction. This destruction has become a problem that demands a prompt solution. To provide better protection for the river network, the benefits or services provided by the river network need to be evaluated, and the attitudes of local communities that are very significant for the conservation of the river network need to be identified.

Previous studies related to river networks primarily examined their natural attributes, such as structure, water quality improvement, sediment, flood control and flow dynamics, or their artificial attributes, such as measures of restoration and reconstruction [2–7]. However, few studies have considered the social-ecological service function of river networks and their value.

The contingent valuation method (CVM), which explores individuals' willingness to pay (WTP) for a change in public goods and serves to detect the costs and benefits that a society receives, is a very commonly used method for the valuation of non-market goods [8]. It was first used by Davis to estimate the benefits of outdoor recreation in a Maine (USA) backwoods area [9]. Subsequently, the CVM was extensively developed throughout the 1970s and 1980s and finally received a major endorsement when the US National Oceanic and Atmospheric Administration (NOAA) proposed the first federal government guidelines for the use of the method in environmental policy analysis in 1993 [10]. The high-frequency use of the CVM and its subsequent federal authorization helped to make the CVM a broadly accepted method of environmental valuation. Since then, the CVM has been widely used to measure the value of types of environmental goods and the improvement of their status. The method has been used to evaluate goods such as air quality, water quality, ecosystem services, biodiversity, and wildlife [11–16] and has even been applied in the fields of waste and resource management [17,18].

Studies concerning the benefits furnished by rivers and evaluations of the river environment or river restoration have increased rapidly in recent years with the increase in awareness of the aesthetic, ecological and environmental, and public social functions of rivers [19,20]. The most widely discussed topics are the benefits of the river ecosystem and river habitat restoration, as in the research of Loomis *et al.* [13], Gürlük [21] and Heide *et al.* [22]. In addition, Amigues *et al.* [23] and Holmes *et al.* [24] evaluated the benefits or costs of the restoration of riparian zones in the contiguous areas of rivers. Other investigations have examined the benefits of river water quality improvement [12,25–28]. Additionally, Willis and Garrod [29], Berrens *et al.* [30] and Ojeda *et al.* [31] tested the values of flow alleviation in rivers, and Carson *et al.* [32] and Thomas and Blakemore [33]

discussed wildlife and its habitat in rivers. Furthermore, Clayton and Mendelsohn [34] and Corrigan *et al.* [35] have discussed the value of watchable wildlife and considered aesthetic value.

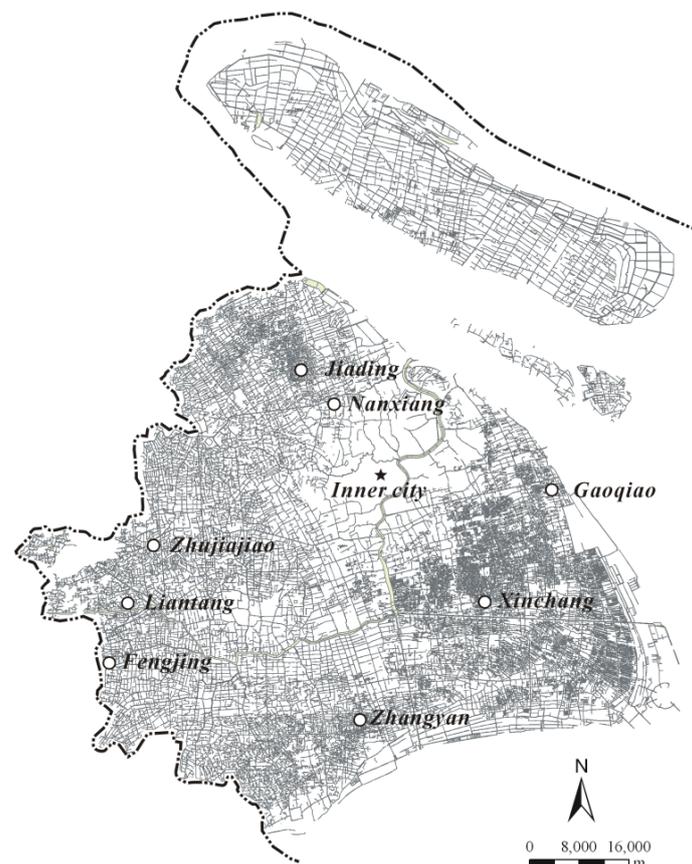
As a result of the overall topography of China, river deltas are the typical landform in eastern China. In the eastern plain areas, such as the Yangtze River Delta or the Pearl River Delta, it is more appropriate to study the value of the river network than that of a selected river. However, studies of the value of the river network are still generally lacking in China. Therefore, through the application of the CVM, this article has the following aims:

- (1) Estimate the benefit of river network protection and analyze factors affecting the WTP and the regional disparity in the WTP between urban and suburban areas.
- (2) Evaluate the public's awareness of and attitude toward the river network and its protection.
- (3) Propose suggestions for the integrated protection of the river network based on the above results.

## 2. Study Area

Shanghai, with a population of more than 20 million in 2010, is one of the largest cities in China. Located at the mouth of the Yangtze River Delta, it is a traditional plain river network area with a high density of rivers. Based on the Shanghai River Survey Report in 2006, there were 33,127 rivers in Shanghai (Figure 1), with a river density of  $3.93 \text{ km/km}^2$  and a percentage of water area as high as 10.1% [36].

**Figure 1.** River network in Shanghai and sampling sites.

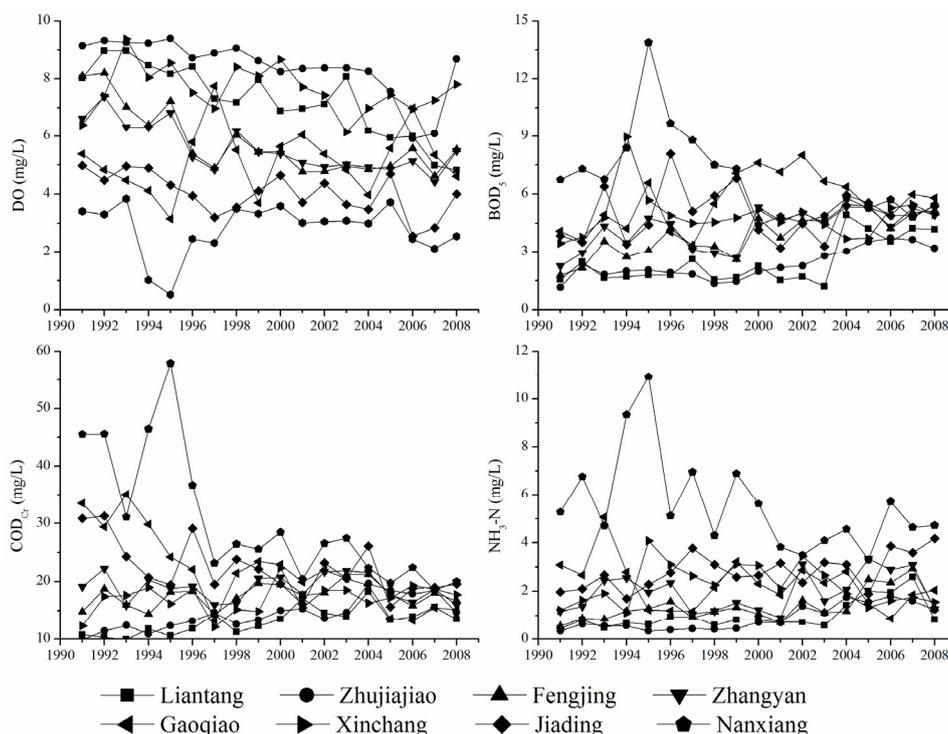


Rapid industrialization has quickly and dramatically changed the appearance of the inner city. During recent decades, human activities have had substantial effects on the river ecosystem. Urban expansion caused a serious and irreversible degradation of the river network structure, and increasing amounts of industrial and domestic pollution unavoidably produced a deterioration of water quality, the “black and stinky” phenomenon. According to the Shanghai Water Resource Bulletin and the Shanghai Environmental Quality Report, surface water quality in Shanghai during the past 30 years has experienced a phase of fast degradation, followed by a phase of slow degradation. After 1996, due to marked progress in urban sewage disposal, the surface water quality has been gradually improved [37].

During the same period, the number and length of rivers have decreased, and the richness of the structure and development of tributaries has been limited. A river network comprising different levels of branches was becoming a network of mainstreams with fewer branches. These changes produced a simplification of the structure of the river network and an inhibition of the development of the river structure. Simultaneously, the historical and cultural values preserved with the rivers were disappearing.

The surface water quality data for eight sampling sites on the tributaries of the river network are selected from the Shanghai Annual Report of Environment Quality 1990–2008. Figure 2 indicates a significant difference in water quality among these river network towns. Evaluated by the Environmental Quality Standard for Surface Water (GB 3838-2002), this dataset shows that organic pollution, which is characterized by five day’s biochemical oxygen demand (BOD<sub>5</sub>) and chemical oxygen demand (COD<sub>Cr</sub>), has improved but still does not meet the requested standards. In addition, ammonia nitrogen (NH<sub>3</sub>-N) substantially exceeded the standard and became the principal water quality problem. Moreover, the dissolved oxygen (DO) levels of these sites showed persistent fluctuations. Overall, the water quality of the river network in Shanghai was unsatisfactory in terms of both the requested standards and the demands of living and tourism.

**Figure 2.** Water quality status of river network around sampling sites in Shanghai.



### 3. Materials and Methods

#### 3.1. Design of Questionnaire

First, a pretest study was used to reduce biases, such as sequencing, information, hypothetical and strategic biases [38], which might affect the respondents to express a WTP. This pretest study was performed with the payment card (PC) method prior to the normal survey to improve the questionnaire and to adjust the series of bid amounts [39]. In the formal survey, a dichotomous-choice contingent valuation method (DC-CVM) format was employed, because it is more cognitively manageable and more similar to the real buying scenario compared to PC format [13,40–42].

The DC-CVM study questionnaire includes four sections in reference to other literature [23,43–45].

The first part includes questions about respondent's socioeconomic information, for example, age, profession, educational level, household population, household income, distance to the nearest river from the respondent's home, number of years lived in Shanghai and environmental education. The second part is used to explore residents' awareness of and attitudes about river network values. In the third section, it detects residents' satisfaction with river network protection. Additionally, the fourth part, which contains the principal valuation questions, aims to evaluate the average WTP and the reasons for the choice of a WTP. The main valuation questions are listed below:

1. Would you pay money to financially assist the government for the improvement of river network (raise connectivity of river network, improve water quality, build riparian zone to make it a proper place for amusement and recreation)?  
A. Yes (Please follow with Question 2) B. No
2. Considering your household expenditures, are you willing to pay (a bid amount) money (per month) from your household income for river network improvement in the next 5 years so that the government could implement this program?  
A. Yes B. No

In this format, the residents were asked to choose among eight bid amounts: 2, 5, 10, 20, 50, 100, 200, and 500 RMB (US\$ 1 = RMB 6.5).

#### 3.2. Data Collection and Valuation Approach

Usually, mail, telephone or face-to-face methods are used in contingent valuation surveys. Of these methods, the face-to-face survey is the most controllable and effective [13,23,30]. However, it is time-consuming [45]. Through face-to-face interviews, the respondents could become acquainted with the concept of the river network, and the purpose of the survey could be presented by the investigators. From March through September 2011, the team conducted a face-to-face questionnaire survey in eight suburban towns (Figure 1) and six urban open spaces (including two university campuses, two residential areas, and two public parks) in Shanghai.

The theoretical model to explain one's WTP is based on the income compensation function if we regard the WTP as the desired benefit measure [16]. In the equation below,  $P$  is the prices for the marketed goods,  $q_1$  is the benefit of the environmental change,  $q_0$  is the baseline of the environmental

goods of interest,  $Q$  is the vector of other public goods,  $I$  is the income and  $C$  is the vector of the respondent's characteristics which affect their tastes and preferences:

$$WTP(q_1) = F(P, q_1, q_0, Q, I, C) \quad (1)$$

A binary logistic regression model was used to identify the significant variables affecting the WTP. Hanemann (1984, 1989) specified the method for calculating the probability that interviewees would pay a given amount of money based on a quantitative choice model [46,47]. The basic formula is:

$$probability(Yes) = 1 - \{1 + \exp[-\alpha + \beta A]\}^{-1} \quad (2)$$

Correspondingly, the mathematical expectation of WTP is:

$$E(WTP) = \frac{1}{\beta} \ln(1 + e^\alpha) \quad (3)$$

where  $\alpha$  and  $\beta$  are coefficients to be estimated with logit statistical techniques and  $A$  is the amount of money the household was asked to pay. PASW 18.0 software was used to perform a logistic regression to calculate the factors influencing the WTP choices.

#### 4. Results and Discussion

The answers to the questionnaire survey were collected, and invalid questionnaires were identified and removed. These invalid questionnaires included 45 incomplete questionnaires (7.5%) and 24 false questionnaires (4%). In the false questionnaires, the willingness to pay for a bid amount was not consistent with the household income. In all, 531 of 600 questionnaires were valid, corresponding to a validity rate of 88.5%. The percentages of valid questionnaires were 38.5% for the urban surveys and 61.5% for the suburban surveys (Table 1). These values were generally representative of Shanghai.

##### 4.1. Socioeconomic Characteristics

The results of the statistical analysis showed that the younger generation (people between 20 and 30 years of age) were the majority (41.43%). "Ordinary workers" represented approximately one-third of the respondents. The overall educational level of the interviewees was relatively low. Approximately 20% of the respondents had a bachelor's degree or above. A family with three members was the most frequent family structure, 45.9% of the total, but families that had four or more members also represented a large proportion of the total (37.1%). The household incomes of the respondents varied within relatively wide limits, but most household incomes ranged between 1,000 and 8,000 RMB per month. Most respondents lived near rivers. For 51.07% of the respondents, the distance to the nearest river from their home was less than 500 m. More than 60% of the respondents lived in Shanghai longer than five years. The percentage of respondents who had relatives or friends engaged in an environmental protection or water resource career was high (34.1%).

**Table 1.** Descriptive statistics of socio-economic characteristics of the respondents.

Item	Response	Percentage (%)	Item	Response	Percentage (%)	
Age	≤20	8.85	Household income (RMB per month)	0–500	1.88	
	21–30	41.43		500–1,000	3.58	
	31–40	19.02		1,000–2,000	11.68	
	41–50	14.12		2,000–3,000	15.07	
	51–60	9.23		3,000–5,000	20.90	
	>60	7.34		5,000–8,000	19.59	
Job	Civil Servant	1.32		8,000–10,000	7.72	
	Researcher	1.13		10,000–15,000	6.59	
	Manager	6.97		15,000–20,000	5.84	
	Medical staff	1.51		20,000–30,000	3.20	
	Teacher	1.69		>30,000	3.95	
	Worker	35.40		Distance to river	0–500 m	51.04
	Private enterprise	11.11			500–1,000 m	22.22
	Farmer	2.82			1,000–2,000 m	12.81
	Student	14.88	2,000–3,000 m		4.14	
	Retired	9.79	3,000–5,000 m		3.20	
Unemployed	2.82	>5,000 m	6.59			
Others	10.55	Years lived in Shanghai	<1 Year	11.11		
Education level	Middle school and below		22.03	1–5 Years	27.87	
	High school		38.79	5–10 Years	18.27	
	Vocational school		17.89	10–20 Years	14.69	
	University	14.50	>20 Years	28.06		
	Graduated	6.59	Job-related influence	Yes	36.16	
Household population	1	1.69		No	63.84	
	2	6.40	District	Urban	38.5	
	3	45.95		Suburban	61.5	
	4	21.09				
	5	16.01				
	≥6	8.85				

4.2. Value Orientation toward River Network

In all, 84.99% of the respondents stated that the river network was a characteristic element that was representative of water towns in Shanghai and the surrounding areas. Of the five features of rivers included in the questionnaire (river form, water quality, riparian zone, velocity and volume, and aquatic life), water quality and aquatic life received more attention than the other features. These results indicated that the local residents attached great importance to the concept of the river network and paid most attention to the primary need, water quality (aquatic life is recognized as a symbol of good water quality). This finding agreed with Maslow’s theory of hierarchy of needs [48].

The interviewees were asked to rank values associated with the river network (eco-environmental value, water town cultural value, and historical heritage value) and structural indexes (river quantity,

river structure, and river connectivity) based on their relative importance. For calibration, the most important option is assigned 3; the second most important option, 2; and the last one is assigned 1.

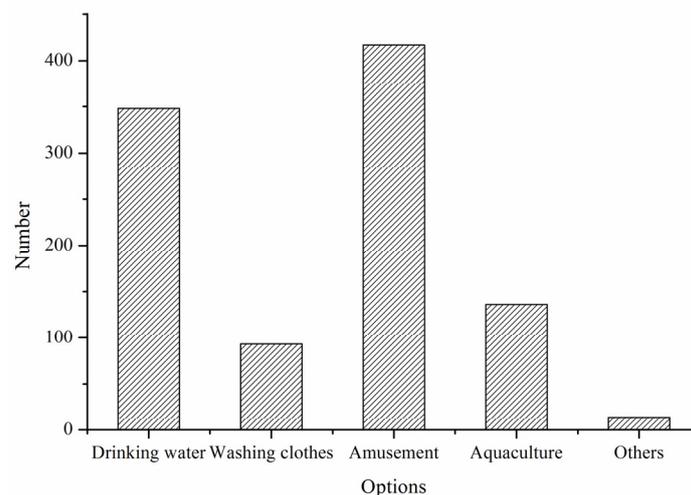
467 respondents reported their rankings about importance of river network values. The result showed that the majority of respondents (58.12%) selected “eco-environmental value” as the most important (total score is 1,143), followed by “historical heritage value” (26.41% of the respondents ranked it the first and its total score is 890) and “water town cultural value” (12.47% of the respondents ranked it the first and its total score is 769). This result indicated that, compared to the values in the esthetic and cultural dimensions, basic living requirement was more important in this period of development and environmental restoration in Shanghai.

481 respondents reported their rankings about importance of river structure. After data calibration, the feature “river connectivity” received the highest score of 1,118 (with 55.10% of the respondents ranked it the first important), followed by “river structure” (scored 960 with 27.86% support of the supreme importance) and “river quantity” (scored 778 with 17.05% support of the supreme importance). This result indicated that although the non-professionals did not achieve a comprehensive understanding of the concept “river connectivity” through indexes, they intuitively recognized its importance for maintaining the integrity of the river network ecosystem [49].

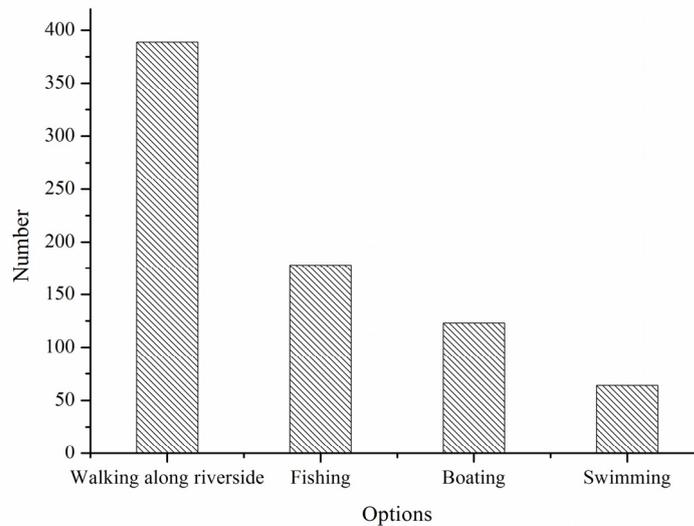
#### 4.3. Recognition of Functions and Services

The questionnaire responses about the function of the river network showed that the entertainment function and the drinking water resource function were most frequently cited by the respondents (78.53% and 65.53%, respectively). Few people used the river network for aquaculture or as a washing place because of the widespread use of the piped water supply and because of the mistrust of river water quality. The responses about the entertainment function indicated that a large portion of the respondents chose to walk along the riverside (73.25%), and that many respondents chose to go fishing (33.52%) or boating (23.16%). In contrast, few respondents (12.05%) chose to swim (Figures 3 and 4). It appeared that the respondents were participating indirectly in the activities supported by the river network. This result may demonstrate the degradation of river quality in terms of condition and accessibility.

**Figure 3.** Frequencies of utilization of functions and services.



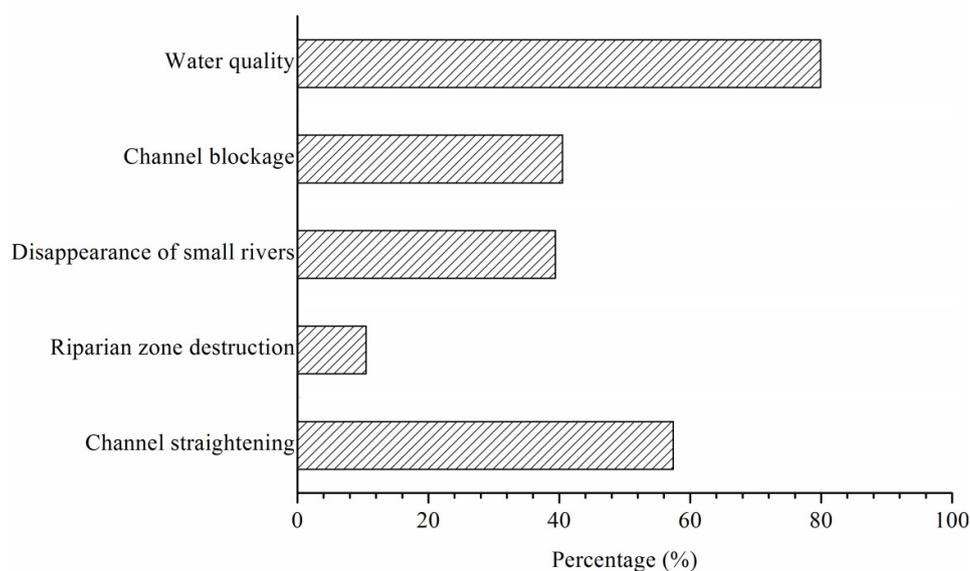
**Figure 4.** Frequencies of utilization of entertainment functions.



*4.4. Awareness of Destruction and Protection*

Two multiple-choice questions were asked about the destruction of the river network. The results of the statistical analysis showed that most respondents recognized the degradation of water quality (79.9%) and channel blockage (57.4%). In all, 39.6% and 40.5% of the respondents chose “destruction of riparian zone” and “landfill of small rivers”, respectively. Only 10.5% chose “channel straightening”. These results indicated that the respondents were very sensitive to the factor of water quality. Thus, river quality improvement was identified as a pressing task (Figure 5).

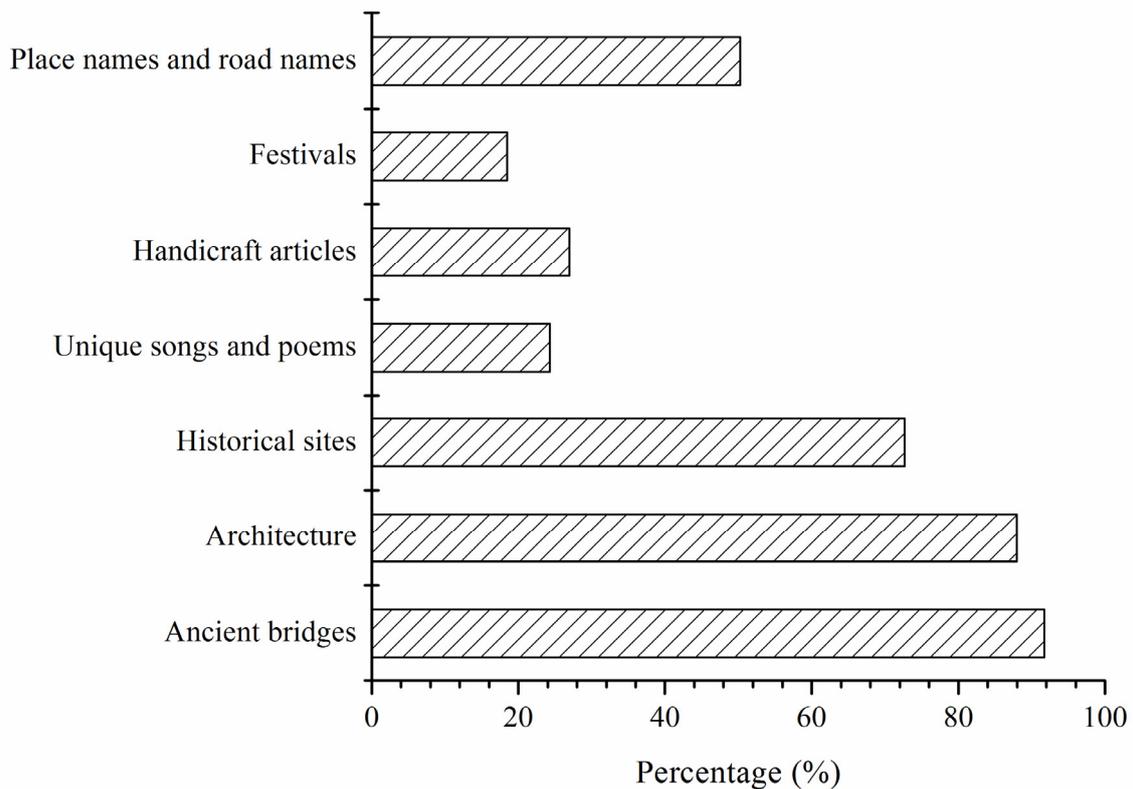
**Figure 5.** Respondents’ awareness of river network degradation.



In addition, most respondents felt that ancient bridges, water town architecture and historical sites had been damaged by different extents (Figure 6). This result indicated that the material elements of the cultural values associated with water towns received the most attention. According to Liu *et al.* [50], the abstract elements of the cultural values (place names and road names, unique songs and poems,

handicraft articles, and festivals) had suffered significant losses during the past few years. The results of this survey indicated that such cultural extinction was relatively unimportant to the local residents surveyed.

**Figure 6.** Respondents’ awareness of disappearance of cultural elements related to the river network.



The respondents were also asked to rate the government’s protection of the current river network and to rate their satisfaction with the results of current river network protection. In all, 53.67% of the respondents felt that the government’s protection was “not bad”, 21.47% thought it was “weak”, and only 12.05% were pleased with the government’s protection. Moreover, only 6.40% of the respondents felt satisfied with the current situation, and 17.70% were disappointed (Table 2). This result revealed that only a small quotient of the citizens thought highly of the government, while a large majority of the respondents believed that there was development space for the managers to improve their work. The more strict policies, more powerful actions, and more reasonable planning in the field of river network protection should be proposed at the first opportunity.

**Table 2.** Respondents’ attitude of protection.

Government’s Degree of Protection			Satisfaction with Current Situation		
Options	Number	Percentage (%)	Options	Number	Percentage (%)
Powerful	64	12.05	Satisfied	34	6.40
Not bad	285	53.67	Tolerable	402	75.71
Weak	114	21.47	Disappointed	94	17.70
Not clear	68	12.81			

#### 4.5. Estimation of WTP and the Total Benefit

Among all 531 respondents, 70.24% (373 people) of the sample reported a positive WTP, whereas 29.75% (158 people) reported a zero WTP (Table 3). The respondents who reported a zero WTP were asked a follow-up question to explore their reasons. A large majority answered “have no extra income” (36.71%), and 1.27% felt the river network was already sufficiently good and did not need protection. Reasons other than a lack of value or the inability to afford a positive WTP were considered a protest vote [51–53]. In this survey, 28.48% of the respondents reported zero WTP because they considered river network protection a responsibility of government, and 22.78% believed that they had paid taxes related to river network protection. Otherwise, 1.27% thought that others would contribute to the government, and 9.49% chose “other reasons”, primarily “a mistrust of funds’ application”.

**Table 3.** Descriptive statistics of WTP distribution.

<b>Bid Amount</b>	<b>2</b>	<b>5</b>	<b>10</b>	<b>20</b>	<b>50</b>	<b>100</b>	<b>200</b>	<b>500</b>	<b>Sum</b>
Sample size	73	70	72	71	70	68	59	48	531
WTP > 0	49	63	49	53	46	48	35	30	373
WTP = 0	24	7	23	18	24	20	24	18	158
$Y_{(WTP>0)\%}$	95.92	96.83	87.76	84.91	71.74	54.17	22.86	16.67	
$N_{(WTP=0)\%}$	4.08	3.17	12.24	15.09	28.26	45.83	77.14	83.33	

The acceptance of the lowest bid (5 RMB) was 95.92%, and that of the highest bid (500 RMB) was 16.67% (Table 3). The mean WTP was calculated with Equation (2) above after excluding the effect of 0WTP and protest responses, as suggested by Hanemann (1989) [47] and Heckman (1978) [54]. The mean WTP found by this study was 226.44 RMB per household per month with the median WTP of 110.375 RMB and the 95% confidence interval of [173.33, 341.51]. According to the most recent report, the number of households in Shanghai was 8.2533 million in 2010. Thus, the value of the river network was 22.43 billion RMB per year. Additionally, this survey showed that “voluntary labor” was the leading activity selected by respondents as a mechanism for contributing to river network protection projects, followed by “donate money” and “resource taxes”.

#### 4.6. Factors Influencing WTP

Table 4 shows that the distance between the home and the river, the number of years lived in Shanghai, and the amount of the bid were statistically significant at the 5% level. The coefficients of these three variables were all negative, but the coefficients of the other variables did not show these effects. The results indicated that people who lived closer to rivers were more willing to pay for protection. This finding was reasonable because the river network was more strongly associated with their homes and daily lives. However, the results also showed that people living in Shanghai for a longer period were not as willing to pay for river network protection as new immigrants. The explanation of this result might be that the original residents who had experienced the improvement of the water environment after the 1980s were satisfied with the current status and might be older people who were retired and frugal. In contrast, the new residents were primarily young people who are more concerned about environmental problems and could contribute money more easily.

**Table 4.** Results from binary logistic regression (WTP > 0, N = 373).

	B	S.E.	Wals	df	Significance	Exp (B)
AGE	0.024	0.115	0.044	1	0.834	1.024
JOB	0.019	0.054	0.116	1	0.734	1.019
EDU (educational level)	-0.007	0.138	0.002	1	0.960	0.993
PEO (household population)	-0.046	0.132	0.120	1	0.729	0.955
INC (household income)	0.108	0.071	2.326	1	0.127	1.114
DIS (distance from river)	-0.241	0.091	7.101	1	0.008	0.786
LYS (years in Shanghai)	-0.234	0.114	4.208	1	0.040	0.792
PRO (environmentally related job)	-0.038	0.297	0.017	1	0.898	0.963
A (payment amount)	-0.012	0.002	48.345	1	0.000	0.988
Constant	2.649	1.063	6.215	1	0.013	14.140
2LogLikelihood				325.502		
Cox & Snell R Squared				0.271		

4.7. Regional Difference in WTP

The analysis showed that the mean WTP of the suburban respondents was high, 626.36 RMB per household per month (95% confidence interval of [489.35, 869.94]), whereas the mean WTP of the urban respondents was only 33.08 RMB per household per month (95% confidence interval of [23.77, 54.42]) (Table 5). This pattern differed strongly from the current economic characteristics of rural and urban areas in Shanghai. First, the WTP calculated by the CVM was always overvalued because people do not actually need to pay for the bid they choose. In rural areas, the educational level of the residents was relatively low. These respondents might choose a high bid amount but lack a comprehensive understanding or careful consideration of the choice. Second, the river network was more accessible to rural residents, whereas the access of the urban citizens to the river was blocked by buildings and flood prevention walls.

**Table 5.** Regional difference between urban and suburban areas.

Area		B	S.E.	Wals	df	Significance	Exp (B)
Urban area	A (payment amount)	-0.010	0.002	18.864	1	0.000	0.990
	Constant	-0.936	1.770	0.279	1	0.597	0.392
	2LogLikelihood				127.678		
	Cox & Snell R Squared				0.235		
Suburban	A(payment amount)	-0.007	0.001	36.247	1	0.000	0.993
	Constant	4.372	1.222	12.802	1	0.000	79.223
	2LogLikelihood				269.420		
	Cox & Snell R Squared				0.213		

Moreover, because the daily lives of the rural residents were more tightly connected with the functions of the river network, the people who lived in the rural areas might choose to devote more attention to the protection of the network. Unfortunately, no significant factors other than the bid were found in the separate logistic regressions for the urban and suburban areas.

#### **4. Conclusions and Recommendations**

The findings of this survey are as follows:

- (1) The river network was valued by most local residents in Shanghai, and its eco-environmental value was the most important of the values examined. Water quality and aquatic life were the aspects of the river network that were ranked most highly, and river connectivity ranked higher than river structure and quantity.
- (2) The functions of the river network as a drinking water resource and as a place used for entertainment were the most frequently recognized services furnished by the river network. In the area of entertainment, indirect uses were more frequently cited than direct uses.
- (3) The destruction of the river network and the degradation of its functions have attracted wide public attention. Decreases in water quality and channel blockage were the most frequently cited forms of deterioration. Material elements of culture, such as bridges, architectures and historical sites, were the focal points in the area of cultural loss. Few residents were satisfied with the current situation and the protection given by the government. More powerful and effective actions for river network protection are needed.
- (4) The mean WTP in the study area was 226.44 RMB per household per month, or 22.43 billion RMB per year within the boundaries of Shanghai. The number of years lived in Shanghai, the distance from the home to the nearest river and the amount of the bid were factors that significantly affected the WTP. The analysis also found a significant difference in the WTP between the urban and suburban areas. This difference was not consistent with the difference in the income levels between these areas.

Based on the conclusions above, the following suggestions for long-term river network protection in Shanghai are proposed:

- (1) The water quality in Shanghai has shown improvement after the development of pollution control projects over the past few decades. In the coming years, the government should begin to shift the target of protection from the simple improvement of water quality to the integrated restoration of the entire river network, including its structure and connectivity. Such ideas should be promoted to convince the public. Because the indirect entertainment services along the riverside are most important, measures should be taken to provide ecological passageways, platforms, and waterfront green space.
- (2) Because of the unique eco-environmental and cultural characteristics of Shanghai, the protection of the river network should be combined with the protection of culture and the development of tourism. The local government should gradually restore the historical features related to the river network.
- (3) The results of the study show that a large proportion of the local residents are willing to pay for river network improvement and protection, thus, economic policy is identified as a flexible instrument for river network management. Efforts to assess and evaluate the status of the river network need to be initiated, and market-based policy should be proposed based on a larger sample collected in selected districts. Ecological compensation or a reward mechanism based on the CVM results might be introduced to support protection.

This study was a positive attempt to apply valuation method to river network protection. It detected the value of river network from a comprehensive view including the attributes like water quality, river structure, and riparian status. The attempt represented the typical willingness and request of residents lived in the districts which were in the dilemma of whether or not to protect environment and develop. Its results may provide a reference for other researchers interested in river network health, behavioral study, and policy research.

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### Conflict of Interest

The authors declare no conflict of interest.

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