Sustainability **2014**, *6*, 6714-6728; doi:10.3390/su6106714

OPEN ACCESS

sustainability

ISSN 2071-1050

www.mdpi.com/journal/sustainability

Article

Determinants of Farmers' Willingness to Pay and Its Level for Ecological Compensation of Poyang Lake Wetland, China: A Household-Level Survey

Fanbin Kong, Kai Xiong and Ning Zhang *

Institute of Poyang Lake Eco-economics, Jiangxi University of Finance and Economics, Nanchang 330032, China; E-Mails: kongfanbin@aliyun.com (F.K.); xk06gg@163.com (K.X.)

* Author to whom correspondence should be addressed; E-Mail: zn928@naver.com or zhangn@jxufe.edu.cn; Tel.: +86-791-8381-0553; Fax: +86-791-8381-0892.

External Editor: Marc A. Rosen

Received: 29 July 2014; in revised form: 31 August 2014 / Accepted: 23 September 2014 / Published: 29 September 2014

Abstract: This study examines the determinants of farmers' willingness to pay (WTP) and their payment levels for ecological compensation of the Poyang Lake Wetland in China. We developed a farmer household survey and gathered 292 effective responses. The contingent valuation method (CVM) and Heckman's two-step model were employed for the empirical study. Results show that 46.58% of farmers are willing to pay ecological compensation, with an average price of $64.39/household per year. The influencing factors that significantly influence farmers' WTP include household income, residential location, emphasis on improvement of wetland resources, arable land area, and contracted water area. In addition, household income, residential location, arable land area, and contracted water area are significantly related to their payment levels. The results of this empirical study inform important policy implications and recommendations.

Keywords: household survey; ecological compensation; willingness to pay (WTP); Poyang Lake Wetland; China

---

1. Introduction

Known as the "kidneys of the earth," [1] wetlands play an extremely important role in alleviating pollution of water resources caused by human activities. Wetlands are not only important natural ecosystems but also a vital economic resource, playing an important role in water supply, water storage, and water construction projects [2]. China has a total wetland area of about 69.4 million ha, accounting for 10% of the world's wetlands [3]. The area of Poyang Lake Wetland is about 2698 km^2 [4]. It is the largest and the most important freshwater wetland in China [5,6]. Poyang Lake Wetland plays an irreplaceable ecological role in flood storage and biodiversity conservation, so much so that it is credited with the maintenance of regional, and even, national ecological security.

However, due to the long-term degradation and depletion of wetland resources, China's wetland areas have been decreasing, and their functions are gradually eroding [7]. Between 1954 and 1997, rampant construction activity significantly reduced the total area of Poyang Lake Wetland from 5160 km^2 to 3859 km^2, translating into a cumulative reduction of 1301 km^2 [8]. Since the late 1990s, a series of ecological restoration measures have been implemented in the Poyang Lake region to curb this trend of wetland degradation. However, the excessive use of the wetland's resources has led to the deterioration of habitats and declining biodiversity, which have not yet been fundamentally reversed. Some rare aquatic animals, such as dolphins and porpoises, are nearly extinct [9].

Given that the status of this wetland ecosystem continues to be exceedingly fragile, its restoration and protection have become key concerns for the national and local governments. A variety of lake wetland management mechanisms operate in China and globally. There are two main types of mechanisms: one is the mandatory regulation mechanism based on administrative means, while the other is the ecological compensation mechanism based on economic means. The ecological compensation mechanism is a new type of resource and environmental management method designed to balance economic development and ecological conservation [10]. These methods are widely used in natural resource compensation research in various venues including water [11], forests [12], and farms [13]. In market economies, the eco-compensation mechanism is also an important and effective management approach for ecological protection. For example, Chicago's corporate wetlands banks are part of its entrepreneurial wetland banking program [14], which aims to effectively resolve the contradictions and conflicts between wetland conservation and utilization. Similar success stories are not uncommon in the "new" economies [15]. In China, ecological compensation was initiated in the 1990s solely to address compensation for the ecological benefits of forests. Without corresponding laws, regulations, policies, and market mechanisms, this effort faced numerous challenges. Currently, the establishment of the Poyang Lake Wetland ecological compensation mechanism has been formally incorporated into the agendas of the central and local Chinese governments; however, the initiative continues to face difficulties in determining the compensating subjects. In terms of the entities managing wetland resources, difficulties in assigning responsibilities and ensuring effective implementation of ecological compensation mechanisms have deterred progress. Previous studies mainly focused on the general resident's WTP; however, few studies have analyzed the WTP of wetland farmers. This study aims to fill this gap by investigating farmers' WTP. The wetland farmers play a very important role in the wetland eco-compensation in Poyang lake wetland; they are both polluters and beneficiaries of the wetlands. The current study is the preliminary study on wetland eco-compensation, further study will identity the

farmers' (willingness to accept) WTA. Finally, we will estimate the ecological compensation standard for farmers with the WTP and WTA. Based the empirical studies, we aim to present some important policy suggestions for making the ecological compensation standard for local wetland farmers.

Therefore, understanding farmers' willingness to pay (WTP) for ecological compensation of the Poyang Lake Wetland, their payment levels, and factors influencing such ecological compensation can theoretically contribute to policy innovations in this area. This study aims to provide pertinent reference values that will help policy makers decide the finer points of the Poyang Lake Wetland compensation mechanism, and ultimately, assist in the overall establishment of a lake wetland ecological compensation policy for China. Notably, no study in China has focused on farmers' WTP in such cases. Therefore, this study aims to fill this gap by investigating the factors influencing farmers' WTP for ecological compensation in this area using a household-level survey.

The rest of this paper is organized as follows. Section 2 presents a literature review. Section 3 explains the data and methodology. Section 4 presents the empirical results and related discussion. Section 5 concludes and provides important policy implications.

2. Literature Review

Wetland ecosystem services are essential to human life, and they are essentially public goods. However, there is not a relative market that expresses these values in China [16]. Estimating the non-use values of public attributes requires a non-market economic valuation method to avoid "*The Tragedy of the Commons*" [17]. Two categories of non-market valuation methods, developed in previous research, are the revealed preference and stated preference methods [18]. The revealed preference category includes the hedonic pricing method (HPM) and the travel cost method (TCM). These methods have been applied to actual market valuation characterized by exchanging economic currency and market goods/services [17]. The stated preference method involves the choice experiment and the contingent valuation method (CVM,) which is used to estimate the value of total ecosystem services [19].

CVM is regarded as one of the most promising methods for valuing public goods [20]. It came into use to estimate the benefits of outdoor recreation in the Maine backwoods of the United States [20]. CVM is widely used in many fields, such as measuring valuation for publicly financed health care services [21], assessing landfill mining projects [22], understanding public perceptions of nuclear power [23], conducting an economic valuation of forest ecosystem services [17], and so on. However, few studies on CVM have focused on Chinese wetlands. No studies on CVM have examined the Poyang lake wetlands, which is one of the most important wetlands in China. This study aims to fill this gap in the literature.

CVM research has made an invaluable contribution to the field by demonstrating that an explicit link between non-market goods and market price is unnecessary [17]. However, there is still a need for understanding of respondents' valuation of public goods [24]. Therefore, CVM is highly suitable for researching farmers' willingness to pay and the level of ecological compensation.

The theoretical basis of China's policy regarding payments for environmental services lies in the principle "Users should protect, destroyers should restore, beneficiaries should pay, and polluters should be charged fees" [25]. Presently, most of the relevant research literature assigns the responsibilities for wetland resource development and utilization to farmers, while the government, private companies, and other social subject are referred to as the beneficiaries of wetland protection. Therefore, policy makers

designing ecological compensation systems typically position farmers only as compensators for ecological restoration and not as compensators for ecological restoration [15,26]. For example, some past studies have focused on farmers' willingness to accept ecological compensation in the Poyang Lake Wetland area [27,28] and the Shanxi Crested Ibis National Nature Reserve [29]. Other related research has followed a similar line of thought [15]. While past research has highlighted the "beneficiaries should pay" principle, it ignores the fact that farmers are both the beneficiaries and the destroyers of wetland resources. Ignoring the negative impact of farmers on wetland resource development and utilization activities is clearly not in the interests of wetland protection and conservation. Therefore, the current system design does not truly reflect the principle guiding ecological compensation, namely, "Users should protect, destroyers should restore." Currently, farmers are not responsible for wetland ecological compensation, which is a major deficiency of the previous studies. Thus, this study contributes by offering a novel research perspective: Not only are farmers the beneficiaries of wetland ecosystems, they are also its destroyers, and thus, ecological compensation for wetlands should be examined from aspect of farmers' WTP and the factors influencing the same.

Methodologically, previous studies mainly used the logit, tobit, and multiple linear regression models to analyze farmers' WTP for ecological compensation. For example, some studies investigated the factors impacting the ecological compensation paid by farmers in the Poyang Lake area [28,30], while others have examined these factors for paddy farmers in the Shanxi Crested Ibis National Nature Reserve [29] using above methods. However, the above models do not examine the factors that influence willingness to pay and the level of payment simultaneously. In particular, the models do not avoid the disturbance of "WTP = 0" samples when examining the factors that influence payment levels. Heckman's two-step model can effectively solve this problem and prevent sample selection bias [31]. Based on the above considerations, we use the contingent valuation method (CVM) to assess farmers' WTP for the ecological compensation of Poyang Lake Wetland and their payment levels. We utilize Heckman's two-step model to analyze the factors influencing the two above mentioned research indexes and their mechanisms. In doing so, we hope to assess the importance of the complementary values on farmers' WTP for ecological compensation of Poyang Lake Wetland and its application to China's overall lake wetland ecological compensation policy.

3. Data and Methods

3.1. Area and Data

Poyang Lake is a freshwater lake fed by water from five important rivers in southern China [32]. The State Council has approved and established the Poyang Lake Ecological Economic Zone, which is divided into the core-protected area, efficient and intensive development area, and lakeside controlled development area. This study examines the core protected and lakeside controlled development areas, including Nanchang County, Xinjian County, Jinxian County, Lushan District, Gongqing cheng City, Dean County, Yongxiu County, Xingzi County, Hukou County, Duchang County, Poyang County, Yugan County, and Dongxiang County.

The data used in this study are sourced from the 2013 and 2014 household surveys designed to assess farmers' WTP for ecological compensation of the Poyang Lake Wetland. Farmers in this area are mainly

engaged in traditional primary industries such as cultivation and plantation. In order to facilitate subsequent comparative studies, we adopt the data from the "2012 Statistical Yearbook of Poyang Lake Ecological Economic Zone" and divide the 13 counties/areas into 3 types based on the ratio of the primary industry production value to the gross regional domestic product. The categories are demarcated as seen in Table 1, with large, medium, and small depicting ratios >20%, 10%–20%, and <10%, respectively.

Table 1. Classification of the study area.

Type	Region	Ratio	Area
I	Duchang, Yugan, Poyang	>20%	Large
II	Xinjian, Jinxian, Yongxiu, Xingzi, Hukou, Dongxiang	10%–20%	Medium
III	Nanchang, Lushan, Dean, Gongqingcheng	<10%	Small

In order to ensure an effective and unbiased study, we use sampling methods appropriate to the town, village, and household levels (Table 2).

Table 2. Sampling methods.

Stage	Sampling Unit	Number	Method
1	Town	26	Stratified sampling
2	Village	1	Probability proportionate to size sampling (PPS)
3	Household	12	Simple random sampling (SRS)

In the first stage, two towns are selected from each county type seen in Table 1 using the stratified sampling method. In the second stage, we select one village from each of the selected towns using the probability proportionate to size sampling (PPS) method. In the last step, we select households from these villages using the simple random sampling method, and then, we survey the households. In total, 292 of 312 questionnaires are found to be effective. The total population is wetland farmers in the Poyang lake area. Our pilot test employed simple random sampling, and found at least 225 respondents fitting the need. We then used the three-stage sampling method to conduct door-to door interviews for 312 respondents, of which 292 were found to provide reliable data. This number is more than the minimum required sample size, and thus the sample is statistically valid for deducing the total population.

3.2. Research Methods

The CVM and Heckman's two-step model are used to quantitatively analyze the obtained household survey data.

3.2.1. Contingent Valuation Method

CVM is a stated preference method [33] involving the hypothetical choices in an administered and well-designed sample survey, based on the direct elicitation of individual's preference [34]. It creates a hypothetical market by asking respondents whether they want to pay as well as the amount they are willing to pay for certain non-market goods [35]. As previously stated, CVM is widely used and has many advantages. Notably, it can measure both use and nonuse values [36,37]. Therefore, CVM can

overcome the limitations of the travel cost method [37] and other traditional calculation methods, such as the proxy goods method and opportunity cost method [38]. However, some researchers doubt its ability to provide valid measures for economic valuation of public goods [36]. For example, stated WTP may be a poor indicator of actual WTP [39]. However, CVM's fundamental utility is supported by most critics, and more careful WTP estimates are encouraged because of this [40].

In this study, we accurately assessed WTP using the valuation method. We used an open-ended WTP questionnaire so that responders would not be restricted by defined values (as in binary choice or closed-ended questions) [41]. We minimized missing responses and explained questions more clearly using face-to-face interviews [20]. Responses to open-ended questionnaires are likely to minimize standard error and lower estimates of central tendency [42], preventing bias [41]. In addition, we finalized the WTP questionnaires and the pre-testing process with experts to guarantee validity and make the questionnaire more clear to respondents.

It is also very important to select a realistic payment vehicle (*i.e.*, how respondents pay the WTP amount) in CVM [43]. Taxes and donations are often used as payment vehicles associated with preservation values [44]. However, donations are more useful payment vehicles for contingent valuation because they provide a reasonable approach for estimating the economic value of small-scale public goods, while respondents may object to mandatory payment schemes (*i.e.*, entrance fees or taxes) [45]. Thus, we used donation as the payment vehicle in this study.

In addition, WTP values are calculated based on mathematical expectation (discrete variables), and the formula is expressed as below:

$$E = WTP = \sum_{i=1}^{n} \alpha_i Pr_i \quad (1)$$

where α_i stands for the amount farmer i is willing to pay, Pr_i represents the probability that farmer i will pay that amount, and n stands for the sample size of farmers whose WTP is positive.

3.2.2. Heckman's Two-Step Model

Heckman's two-step method is a statistical method that allows for accurate sample selection bias, for which Heckman [46] accepted the Economic Nobel Prize in 2000 [47]. We had two reasons for using Heckman's two-step model in the study. First, it allowed us to examine the two steps leading to farmers' decisions in a single model while distinguishing the influence of different factors between these two steps [31]. In other words, we were able to investigate the influence factors of willingness to pay along with payment level in a single model. We could then use the model to analyze the factors influencing farmers' payment levels simultaneously, and prevent the disturbance of farmers whose WTP was zero. Secondly, the model could explicitly resolve potential sample selection bias [31,48]. Since the population in our study was quite large with no boundaries, sampling could only define the scope that was selected by the researchers. It is, therefore, possible to insert irrelevant variables, or to choose not to include associated variables in the sample, which may cause sample selection bias [46]. Therefore, we used Heckman's two-step model to prevent these problems.

Variables: Eight indicators/variables are designed [29,30,49,50] to evaluate the changes in WTP and the payment levels of farmers in the study area (Table 3).

Table 3. Variables and description.

Variable	Unit	Description	Related Supporting Documents
Gender (X_1)	Male = 1, Female = 0	These variables evaluate the possible impacts on farmers' WTP and their payment levels, using individual and household-level information.	[29,30,49]
Number of family members (X_2)	Persons		[29,30,50]
Annual household income (X_3)	Yuan (¥)		[29,30,50]
Source of income (X_4)	Cultivation = 1, Otherwise = 0		[30]
Residential location (X_5)	Region I or II = 1, Region III = 0		[29]
Emphasis on improvement of wetland resources (X_6)	Yes = 1, No = 0	This variable evaluates the impacts of the farmers' concern and knowledge about environmental issues pertaining to wetlands on WTP and their payment levels.	[49,50]
Arable land area (X_7)	Acres	These variables examine whether the cultivation area and contracted water area impact farmers' WTP and their payment levels.	[29,30]
Contracted water area (X_8)	Acres		[29,30]

Model selection: This study uses Heckman's two-step model to estimate the factors influencing WTP and payment levels. First, we use the probit model to test the factors influencing WTP. Second, we use the multiple linear regression model to further investigate the factors influencing payment levels. Specifically, the models are expressed as follows:

$$Z = \partial_0 + \partial_1 X_1 + \partial_2 X_2 + \partial_3 X_3 \cdots + \partial_n X_n + \varphi \quad (2)$$

Equation (2) is the first-stage Heckman probit model. Z is the dependent variable, which represents the probability of wetland farmers' WTP. $\partial_0, \partial_1, \partial_2, \partial_3, \cdots, \partial_n$ are coefficients that will be estimated while examining the factors affecting farmers' WTP $X_1, X_2, X_3 \cdots, X_n$ are the explanatory variables, and φ is the residual term.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \cdots + \beta_n X_n + \delta\lambda + \mu \quad (3)$$

Equation (3) is the multiple linear regression model used in the second stage of our analysis. Y is the dependent variable, which examines factors affecting the farmers' payment levels. In this paper, we add Mills ratio, λ, to overcome the sample selection bias [36]. $\beta_0, \beta_1, \beta_2, \beta_3, \cdots, \beta_n$ and δ are the coefficients to be estimated. $X_1, X_2, X_3 \cdots, X_n$ are the explanatory variables, and μ is the residual term.

4. Empirical Study

4.1. WTP and Payment Levels

As shown in Table 4, 46.58% of farmers have positive WTP, while 53.42% of farmers do not.

Table 4. Frequency of willingness to pay (WTP).

WTP	Number	Sample Size	Proportion
Yes	1	136	46.58%
No	0	156	53.42%

We use Equation (1) to estimate the payment levels in regions I, II, and III. The results appear as Equations (4)–(7) (see Figure 1).

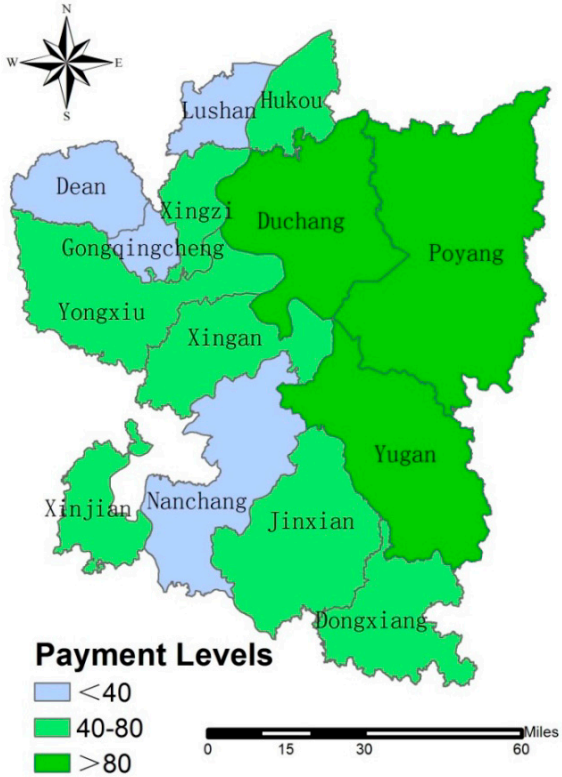
$$\mathrm{E}(WTP_I) = \sum_{i=1}^{n} \alpha_i Pr_i = 97.05 \quad (4)$$

$$\mathrm{E}(WTP_{II}) = \sum_{i=1}^{n} \alpha_i Pr_i = 62.80 \quad (5)$$

$$\mathrm{E}(WTP_{III}) = \sum_{i=1}^{n} \alpha_i Pr_i = 34.32 \quad (6)$$

$$\mathrm{E}(WTP\ all) = \sum_{i=1}^{n} \alpha_i Pr_i = 64.39 \quad (7)$$

Figure 1. Distribution of farmers' payment levels in the Poyang Lake Wetland area.



The value measured as the Chinese currency (RMB Yuan) is converted into US $ value by the average exchange rate during 2012–2013 (RMB 6.252 yuan to one dollar) per household per year.

The results in Equations (4)–(7) and Figure 1 show that the payment levels of all farmers toward the ecological compensation of Poyang Lake Wetland area is $64.39/household per year. The highest payment levels, $97.05/household per year, occurs in region I. The second-highest level of household

payment, \$62.80/household per year, occurs in region II. The lowest level of household payment, \$34.32/household per year, is seen for region III. The results also indicate that the higher the regional agricultural production, the higher the payment levels of the household willing to pay for ecological compensation.

4.2. Results of the Regressions

Heckman's two-step model is applied using Stata11.0. The farmers' WTP and their payment levels are used as the dependent variables, while household characteristics are used as the independent variables. The result is shown in Tables 5 and 6.

Table 5. First-stage probit analysis.

Variable	C	SE	Z	P > |Z|
Constant	−2.245 ***	0.575	−3.900	0.000
X_1	0.651	0.433	1.510	0.132
X_2	−0.056	0.080	−0.690	0.488
X_3	1.63×10^{-7}	2.00×10^{-6}	0.08	0.935
X_4	1.256 ***	0.274	4.580	0.000
X_5	−1.051 **	0.315	−3.330	0.001
X_6	2.415 ***	0.313	7.730	0.000
X_7	0.349 **	0.104	3.360	0.001
X_8	0.152 *	0.092	1.650	0.098

Note: ***, **, and * represent significance at 1%, 5%, and 10%, respectively.

Table 6. Second-stage multiple linear regression analysis.

Variable	C	SE	Z	P > |Z|
Constant	−60.250	89.297	−0.670	0.500
X_3	0.004 ***	0.001	4.330	0.000
X_5	271.517 ***	90.725	2.990	0.003
X_7	28.609 ***	4.049	7.060	0.000
X_8	30.946 ***	3.277	9.440	0.000
λ	155.600 **	77.718	2.000	0.045

Note: *** and ** represent significance at 1% and 5%, respectively.

It should be noted that eight explanatory variables are incorporated in the first stage, and four explanatory variables are introduced in the second stage. This is because Heckman's model should include at least one variable in the first stage that is different from the variables included in the second stage. That is, all explanatory variables must be contained in the first stage, while the second stage must contain fewer variables than the first stage [51]. Based on this principle, the second stage regress the variables with statistically significant values.

4.3. Factors Affecting WTP

The probit model indicated in Table 5 shows that source of income (X_4), residential location (X_5), emphasis on the improvement of wetland resources (X_6), arable land area (X_7), and contracted water area

(X_8) are significantly related to WTP, while gender (X_1), family size (X_2), and household income (X_3) do not show statistical significance. X_4 is statistically significant with WTP, and the coefficient is positive, which means that farmers relying mainly on agricultural products for their incomes have stronger WTP. It may be that when a farmer's household income is sourced mainly from planting, breeding, and other traditional industries, environmental quality improvements are likely to be more beneficial to him, and therefore, such farmers are more willing to compensate the environment. X_5 is statistically significant with WTP, and the coefficient is negative, which means that farmers living in regions I and II have stronger WTP than those living in region III. This may be because the different levels of agricultural production in regions I, II, and III may affect farmers' WTP; farmers living in regions I and II will earn more from their ecological environment, and therefore, they have a stronger WTP. X_6 is statistically significant with WTP, and the coefficient is positive, indicating that farmers who pay close attention to wetland environmental improvements are more willing to compensate their environment. It may be that such farmers are dissatisfied with the current environmental quality of the wetland, which enhances their willingness to compensate the environment in order to improve it. X_7 is statistically significant with WTP, and the coefficient is positive; the more arable land the farmers have, the stronger their WTP. It may be that farmers with more arable land earn well from farming. Thus, if their environmental quality deteriorates, their incomes from farming would reduce. As a result, they are more willing to compensate the environment. X_8 is also statistically significant with WTP, and the coefficient is positive. Thus, the higher the contracted water area, the stronger the WTP. It may be that farmers with higher contracted water areas earn more revenue from fishing. Given the relation between fishing and the quality of the wetland environment, these farmers would be more willing to compensate the environment in order to protect it.

4.4. Factors Affecting Payment Levels

The multiple linear regression model shown in Table 5 indicates that household income (X_3), residential location (X_5), arable land area (X_7), and contracted water area (X_8) are significantly related to payment levels. X_3 is statistically significant with the payment levels, and the coefficient is positive; thus, the payment levels will increase as the incomes of the farmers with positive WTP increases. It maybe that the incomes of such farmers are closely linked with the wetland resources; therefore, their increasing incomes encourage them to pay more money to protect the wetland environment. That is, the higher the increase in farmers' incomes, the more their WTP. X_5 is also statistically significant with the payment levels and displays a positive coefficient. This means that the farmers living in regions I and II have higher WTP than those living in region III. This result may be attributed to their sources of income. The incomes of the farmers living in regions I and II depend more on agricultural (grain) production and fishing. Therefore, they are more willing to compensate the environments o as to potentially increase their incomes.

X_7 is also statistically significant with the payment levels and shows a positive coefficient. Thus, farmers having WTP and possessing more arable land will have higher payment levels; the more their arable land, the higher the portions of their incomes from planting, which in turn is closely connected to the environment. Therefore, farmers who have more arable land are willing to pay higher sums in order to protect the wetland environment. X_8 is statistically significant with the payment levels as well and has

a positive coefficient. Therefore, farmers who are willing to pay have contracted a higher area of water and will have higher payment levels. It maybe that the higher the contracted water area, the higher the portions of their incomes from aquatic products. Therefore, the better the environmental quality is, the higher the farmer's potential income and his payment levels are. In addition, the coefficient of λ is not zero and is statistically significant, which indicates that the sample suffers from selection bias. Therefore, this result confirms our selection of Heckman's two-step model to examine the factors affecting farmers' WTP and their payment levels.

5. Conclusions and Implications

This study examined the determinants of farmers' WTP for ecological compensation of the Poyang Lake Wetland area in China and their payment levels, using farmer household-level survey data. The CVM and Heckman's two-step model were employed. The results show that 46.58% of farmers have positive WTP, with their average annual WTP being $64.39/household. The empirical results show that household income, residential location, emphasis on improvement of wetland resources, arable land area, and contracted water area have a significant correlation with the farmers' WTP, and household income, residential location, arable land area, and contracted water area have a significant correlation with the farmers' payment levels.

In order to effectively improve the farmers' WTP for the ecological compensation of Poyang Lake Wetland and their payment levels, it is necessary to promote the establishment and implementation of the Poyang Lake Wetland ecological compensation mechanism. The following policy implications would serve the purpose.

First, the government should raise the farmers' awareness about their obligations to wetland ecological protection and their liabilities for damage caused to the area. Experience has shown that it is difficult to levy compensation funds from the farmers, who traditionally view the long-term use wetland resources as being free. Thus, there are serious gaps between the concept's ideology and actual implementation. Although the law obligates citizens to protect natural resources and the environment and mandates legal liabilities for any breaches, farmers residing in the National Lake District consider the use of all wetland resources as their traditional right. The uninhibited and excessive use of wetland resources causes ecological losses, which could be lessened by improving farmers' awareness about these issues. Increased raising of awareness on the topic will help farmers recognize the illegality of such exploitative behavior and the negative impacts of wetland resource depletion and degradation, thus laying a solid ideological foundation for the successful establishment of an ecological compensation system for lake wetlands throughout the country. Secondly, establish rural cooperatives to produce wetland agricultural products such as fish, shrimp and vegetables for farmers. Encourage farmers to join cooperatives for joint development of wetland resources. In addition, the government should proactively support capital loans and technology that benefit more farmers in terms of wetland resources. Thus, the farmers will have the willingness to continually expand the sale of wetland products. Based on empirical results of this study, income and land area are positively linked to payment level. Therefore, when more farmers are willing to pay for wetland resources, it benefits development of these resources and increases the economic benefits of these wetland resources. Third, we recommend developing a special wetland protection fund for real money generated by farmers' willingness to pay, using the fund for the

wetland ecological protection. We also recommend that state and local governments offer financial support to continually increase investment in wetland conservation. The local government should also communicate with transparency. Improving and protecting wetland environments promise to increase farmer's incomes and their quality of life, therefore benefiting China as a whole. Fourth, it is important to clarify the property rights of the Poyang Lake Wetland area. Field surveys show state-owned and collective-owned property rights for Poyang Lake Wetland resources, but the limits of the geographical boundaries are unclear. The operating property rights of the farmers have not been implemented. Blurred property boundaries not only increase the difficulties of wetland management but also hinder the establishment and implementation of wetland ecological compensation systems. Defining property rights to the wetland's resources can provide the fundamental institutional guarantees so necessary for ecological compensation mechanisms. Fifth, establishing an ecological compensation system database to serve rural households around lakes should be the government's priority. This exercise may be taken up as part of an annual census, wherein the relevant government departments would collate all the information related to ecological compensation, such as household income sources, arable land area, contracted water area, *etc.* Improved survey data would provide an important foundation for assessing farmers' WTP and help the development of specific standards in the field. Sixth, the government should develop differentiated ecological compensation standards. In accordance with the varying characteristics/heterogeneity of rural households, it may be prudent to develop different ecological compensation fund levies or disbursement criteria. Seventh, the in-depth study of the specific ecological compensation mode/operation system for the Poyang Lake Wetland shows that it is necessary for farmers to be able to pay for ecological compensations using payment patterns convenient to them. These patterns would differ by regional characteristics and may include payment methods such as compensation via labor, equipment, and/or money. Such choices would improve the farmers' ability to make payments toward ecological compensation.

This study has some limitations. The empirical analysis is based on data only for the 2012–2013 period. Therefore, future research should consider a longer period, by considering a broader sample. Another limitation is there is no reference set for farmer's WTP answer; thus, the answer might be biased. To overcome this limitation, future study may consider using the open-ended survey. Further study could investigate willingness to accept of farmers. By combining WTP and WTA, the ecological compensation standard can be estimated for wetland farmers.

Acknowledgments

This research was funded by the National Major Social Science Fund of China (12&ZD213), National Science Foundation of China (41261110, 41461118), China Postdoctoral Foundation (2014M551849) and Humanities and Social Science Fund of Jiangxi (JJ1420).

Author Contributions

Fanbin Kong designed research idea; Kai Xiong collected research and analyzed the data; Ning Zhang revised the manuscript. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

References

1. Gopal, B.; Ghosh, D. Natural wetlands. In *Reference Module in Earth Systems and Environmental Sciences Encyclopedia of Ecology*; Academic Press: Waltham, MA, USA, 2008; pp. 2493–2504.
2. Bostian, M.B.; Herlihy, A.T. Valuing tradeoffs between agricultural production and wetland condition in the U.S. Mid-Atlantic region. *Ecol. Econ.* **2014**, *105*, 284–291.
3. Liu, H.Y. China's wetland resources characteristics, present situation and ecological security. *Resour. Sci.* **2005**, *29*, 54–60.
4. Huang, J.G.; Guo, Z.Y. Poyang Lake wetland conservation of biological diversity and its countermeasures. *Res. Soil Water Conserv.* **2007**, *23*, 305–306.
5. Wei, Y.H.; Zhang, J.Y.; Zhang, D.W.; Tu, T.H.; Luo, L.G. Metal concentrations in various fish organs of different fish species from Poyang Lake, China. *Ecotoxicol. Environ. Saf.* **2014**, *104*, 182–188.
6. Zhao, Z.H.; Zhang, L.; Cai, Y.J.; Chen, Y.W. Distribution of polycyclic aromatic hydrocarbon (PAH) residues in several tissues of edible fishes from the largest freshwater lake in China, Poyang Lake, and associated human health risk assessment. *Ecotoxicol. Environ. Saf.* **2014**, *104*, 323–331.
7. Zhang, Q.; Xiao, M.Z.; Li, J.F.; Singh, V.P.; Wang, Z.Z. Topography-based spatial patterns of precipitation extremes in thePoyang Lake basin, China: Changing properties and causes. *J. Hydrol.* **2014**, *512*, 229–239.
8. Qian, D.Q.; Liu, C.Y. Poyang lake wetland ecological protection and sustainable utilization research. *Acta Pedol. Sin.* **2002**, *23*, 318–326.
9. Liu, Y.; Peng, W. Social economic driving force analysis of the Poyang lake wetland ecosystem degradation. *Jiangxi Soc. Sci.* **2003**, *24*, 231–233.
10. Kong, F.B. Improving ecological compensation mechanism of China: Theory, practice and research prospects. *Issues Agric. Econ.* **2007**, *10*, 50–53.
11. Shen, N.; Pang, A.P.; Li, C.H.; Liu, K.K. Study on ecological compensation mechanism of Xin'an Spring Water Source Protection Zone in Shanxi province, China. *Procedia Environ. Sci.* **2010**, *2*, 1063–1073.
12. Li, F.; Li, W.H.; Zhen, L.; Huang, H.Q.; Wei, Y.J.; Naomi, I. Estimating eco-compensation requirements for forest ecosystem conservation: A case study in Hainan province, southern China. *Outlook Agric.* **2011**, *40*, 51–57.
13. Robert, H.; Oliver, B.; Ingrid, J.; Matthias, S.; Lukas, P. Motivations for implementation of ecological compensation areas on Swiss lowland farms. *J. Rural Stud.* **2014**, *34*, 26–36.
14. Robertson, M.; Hayden, N. Evaluation of a market in wetland credits: Entrepreneurial wetland banking in Chicago. *Conserv. Biol.* **2008**, *22*, 231–233.
15. Kong, F.B. *Poyang Lake Ecological Economic Zone Issue of Environmental Protection and Ecological Poverty*; China Environmental Science Press: Beijing, China, 2011.

16. Robert, C.; Ralph, A.; Rudolf, G.; Stephen, F.; Monica, G.; Bruce, H.; Karin, L.; Shahid, N.; Robert, V.O.; Jose, P.; *et al.* The value of the world's ecosystem services and natural capital. *Nature* **1997**, *387*, 253–260.
17. Tao, Z.; Yan, H.M.; Zhan, J.Y. Economic valuation of forest ecosystem services in Heshui watershed using contingent valuation method. *Procedia Environ. Sci.* **2012**, *13*, 2445–2450.
18. Monica, I.O.; Alex, S.M.; Barry, D.S. Economic valuation of environmental services sustained by water flows in Yaqui River Delta. *Ecol. Econ.* **2008**, *65*, 155–166.
19. Loomis, J.B.; Kent, P.; Strange, L.; Fausch, K.; Covich, A. Measuring the total economic value of restoring ecosystem services in an inpaired river basin: Results from a contingent valuation survey. *Ecol. Econ.* **2000**, *33*, 103–117.
20. Mitchell, R.C.; Carson, R.T. *Using Surveys to Value Public Goods: The Contingent Valuation Method*; Resources for the Future Press: Washington, DC, USA, 1989.
21. Tambor, M.; Pavlova, M.; Rechel, B.; Golinowska, S.; Sowada, C.; Groot, W. Willingness to pay for publicly financed health care services in Central and Eastern Europe: Evidence from six countries based on a contingent valuation method. *Soc. Sci. Med.* **2014**, *116*, 193–201.
22. Marella, C.; Raga, R. Use of the Contingent Valuation Method in the assessment of a landfill mining project. *Waste Manag.* **2014**, *34*, 1199–1205.
23. Sun, C.W.; Zhu, X.T. Evaluating the public perceptions of nuclear power in China: Evidence from a contingent valuation survey. *Energy Policy* **2014**, *69*, 397–405.
24. Venkatachalam, L. The contingent valuation method: A review. *Environ. Impact Assess. Rev.* **2004**, *24*, 89–124.
25. Wang, D.H. Issues to explore the establishment of ecological compensation mechanism. *Environ. Prot.* **2006**, *34*, 12–17.
26. Wang, Y.; Yan, J. Farmers' ecological compensation Willingness to accept analysis of the Nature Reserve—Take Shaanxi crested ibis nature reserve as example. *Chin. Rural Econ.* **2010**, *26*, 63–73.
27. He, J. Based on Poyang Lake Wetland Ecosystem Services and Ecological Compensation Community Research. Ph.D. Thesis, Jiangxi Normal University, Nanchang, China, 2009.
28. Jiang, H.Y.; Wen, Y.L. Based on the WTA wetlands surrounding farmers willingness to compensation and influencing factors research. *Resour. Environ. Yangtze Basin* **2011**, *20*, 489–494.
29. Wang, C.H.; Cui, L.J.; Mao, X.F. Wetland ecological compensation area surrounding farmers willingness comparison. *Acta Ecol. Sin.* **2012**, *32*, 5345–5354.
30. Li, F.; Zhen, L.; Qing, H.Q. Willingness of farmers to compensate the impact of ecological factors in Poyang Lake region. *Resour. Sci.* **2010**, *34*, 824–830.
31. Kim, J.; Jang, S.C. Dividend behavior of lodging firms: Heckman's two-step approach. *Int. J. Hosp. Manag.* **2010**, *29*, 413–420.
32. Cui, L.J. Poyang lake wetland ecosystem service function value evaluation research. *Chin. J. Ecol.* **2004**, *23*, 47–51.
33. Hanemann, M.W. Discrete/continuous models of consumer demand. *Econometrica* **1984**, *52*, 541–562.
34. Arrow, K.J.; Solow, R.; Leamer, E.; Portney, P.; Radner, R.; Schuman, H. Report of the NOAA panel on contingent valuation. *Fed. Regist.* **1993**, *58*, 4601–4614.

35. Bengochea-Morancho, A.; Fuertes-Eugenio, A.M.; del Saz-Salazar, S. A comparison of empirical models used to infer the willingness to pay in contingent valuation. *Empir. Econ.* **2005**, *30*, 235–244.
36. Johnson, B.K.; Whitehead, J.C.; Mason, D.S.; Walker, G.J. Willingness to pay for downtown public goods generated by large, sports-anchored development projects: The CVM approach. *City Cult. Soc.* **2012**, *3*, 201–208.
37. Armbrecht, J. Use value of cultural experiences: A comparison of contingent valuation and travel cost. *Tour. Manag.* **2014**, *42*, 141–148.
38. Van den Berg, B.; Al, M.; Brouwer, W.; von Exel, J.; Koopmanschap, M. Economic valuation of informal care: The conjoint measurement method applied to informal caregiving. *Soc. Sci. Med.* **2005**, *61*, 1342–1355.
39. Carson, R.T.; Mitchell, R.C. The issue of scope in contingent valuation studies. *Am. J. Agric. Econ.* **1993**, *75*, 1263–1267.
40. Sattout, E.J.; Talhouk, S.N.; Caligari, P.D.S. Economic value of cedar relics in Lebanon: An application of contingent valuation method for conservation. *Ecol. Econ.* **2007**, *61*, 315–322.
41. O'Conor, R.M.; Johannesson, M.; Johanesson, P. Stated preferences, real behavior and anchoring: Some empirical evidence. *Environ. Econ.* **1999**, *13*, 235–248.
42. Boyle, K.J.; Johnson, F.R.; McCollum, D.W.; Desvousges, W.H.; Dunford, R.W.; Hudson, S.P. Valuing public goods: Discrete *versus* continuous contingent-valuation responses. *Land Econ.* **1996**, *72*, 381–396.
43. Lee, C.K.; Han, S.Y. Estimating the use and preservation values of national parks' tourism resources using a contingent valuation method. *Tour. Manag.* **2002**, *23*, 531–540.
44. Lee, C.K.; Mjelde, J.W. Valuation of ecotourism resources using a contingent valuation method: The case of the Korean DMZ. *Ecol. Econ.* **2007**, *63*, 511–520.
45. Champ, P.; Bishop, R.; Brown, T.; McCollum, D. Using donation mechanisms to value nonuse benefits from public goods. *J. Environ. Econ. Manag.* **1997**, *33*, 151–162.
46. Heckman, J. Sample selection bias as a specification error. *Econometrica* **1979**, *47*, 153–161.
47. Heckman Correction. Available online: http://en.wikipedia.org/wiki/Heckman_correction (accessed on 23 August 2014).
48. Bett, H.K.; Peters, K.J.; Nwankwo, U.M.; Bokelmann, W. Estimating consumer preferences and willingness to pay for the underutilised indigenous chicken products. *Food Policy* **2013**, *41*, 218–225.
49. Ge, Y.X.; Liang, L.J.; Wang, B.B. Residents the Yellow River basin ecological compensation intention and pay level analysis—Take Shandong province as an example. *Chin. Rural Econ.* **2009**, *25*, 77–85.
50. Cai, Z.J.; Zhang, W.W. Nanjing Yangtze River water quality improvement of the public's willingness to pay and the payment of the investigation. *Ecol Econ.* **2007**, *23*, 116–119.
51. Baum, C.F. *An Introduction to Modern Econometrics Using Stata*; Stata Press: College Station, TX, USA, 2006.