Information Effect on Farmers' Willingness to Participate in Wetlands Restoration: The Case of China Poyang Lake Wetlands Restoration Program

Zhengfei Guan *
Assistant Professor
Gulf Coast Research and Education Center &
Food and Resource Economics Department
University of Florida
14625 CR 672, Wimauma, FL 33598, USA
phone: +1-813-633-4138
email: guanz@ufl.edu

Honggen Zhu
Professor
School of Economics and Management
Jiangxi Agricultural University
1101 Zhimin Road, Nanchang, Jiangxi 330045, China
phone: +86-791-83828438
email: zhgen2004@163.com

Xuan Wei
Post-doctoral Associate
Gulf Coast Research and Education Center
University of Florida
14625 CR 672, Wimauma, FL 33598, USA
phone: +1-813-633-4127
email: wei.xuan@ufl.edu

May 2015

Selected Paper prepared for presentation at the 2015 Agricultural & Applied Economics Association and Western Agricultural Economics Association Annual Meeting, San Francisco, CA, July 26-28, 2015

As the largest freshwater lake in China, the Poyang Lake and its wetlands have been playing important roles in providing a large buffer for flood management in several provinces in the Middle and Eastern China, supplying water resources for production, regulating climate, and providing wildlife habitats. However, as a result of decades-long reclamation and development, the wetlands have largely disappeared, which caused environmental issues such as frequent drought and flooding in the region and the lower reach of the Yangtze River, loss of wildlife habitats, and destruction of wetlands ecosystem. In order to address issues associated with wetlands ecosystem degradation, China central and provincial governments have made a policy U-turn since the 1990s. Different wetlands protection and management measures have been proposed and implemented to actively promote wetlands restoration and relocate local communities out of the wetlands area. The Poyang Lake wetlands have been a focal point of China's wetland ecosystem restoration initiatives because of the scale of the wetlands and their socioeconomic and environmental functions.

Local farmers' willingness to forgo agricultural production on reclaimed lands and participate in wetland restoration is critical for the success of the wetlands restoration initiatives. Providing information about wetlands functions and benefits is an important option available to policy makers to motivate farmers' participation in wetland restoration. However, the relationship between information and farmers' willingness to participate in wetland restoration is not clear. In terms of wetland restoration, farmers' environmental concerns are closely related to beliefs about the consequences of environmental changes for their valued objects (Stern and Dietz, 1994). Farmers' background and other socio-economic variables will affect their beliefs and the way they process information, and their receptivity to the information. In this research we investigate the information effect by presenting farmers with information on wetlands and then analyzing the change in their attitudes toward wetlands restoration participation. By comparing their pre- and post-treatment

willingness to participate, this study aims to examine how information and educational materials may affect farmers' willingness to participate in wetlands restoration initiatives and identify the underlying factors affecting information effect.

Review of Previous literature

Information may indirectly affect individual behaviors toward or against more environmental friendly practices by altering their beliefs, knowledge and environmental protection awareness. Empirical results regarding the relationship between information and individual attitudes are mixed and indicate how information influence individual attitudes may depend on the source of information and the type of information provided. Lichtenberg and Zimmerman (1999) found that farmers who attached greater importance to information from news media and extension expressed greater environmental concern while farmers who found information from chemical dealers more important expressed greater concern about potential jeopardy to wildlife and pesticides in drinking water but less concern about general environmental quality problems associated with agricultural chemicals. Rhodes et al. (2002) compiled an index using the number of information categories (such as pamphlets and media articles) farmers were exposed to and used it to assess relationships between the index score and farmers' attitudes towards riparian management strategies, and they found the positive relationships between the two. However, some studies claimed information has negligible effect on altering individual's attitudes. Napier et al. (1986) showed that the frequency of use of either institutional or non-institutional information does not have a statistically discernible influence on the degree of individual's environmental concern.

The present study aims to shed light on the effect of informational program (e.g., extension and farmer education) on wetlands restoration participation. In the literature there is a large body of empirical research on wetlands ecosystem service and protection. Some of them attempted to

address the farmers' willingness to pay (WTP) or willing to accept (WTA) for wetlands services. For instance, Loomis (1990) surveyed the general population in California about their willingness-to-pay for wetland protection in the San Joaquin Valley. Whitehead and Blomquist (1991) used the contingent valuation (CE) method to estimate the total economic value of the Clear Creek wetland in western Kentucky. Another mainstream is to identify factors affecting wetland creation or restoration. Söderqvist (2003) found that in addition to private profitability, environmental benefits were also essential in determining farmers' participation in wetland creation in Southern Sweden. Dedah (2010) found that in addition to landowner characteristics, risk aversion played an important role in determining the likelihood of participation as well as the amount of investment in wetland restoration and maintenance projects. Yu and Belcher (2011) suggested that payment is an important factor in landowners' conservation adoption decision. Other impacting factors include landowner experience, planning horizon, and perceptions of wetland values.

However, to our knowledge, little has been done to quantitatively assess the effectiveness of environmental information on farmers' willingness to participate in wetland restoration. This paper seeks to fill this research gap by estimating the effect of environmental information about wetland functions and benefits on farmers' willingness to participate in Poyang lake wetland restoration. In this research we developed an educational video on wetlands and their functions and played the video to interviewed farmers in an experiment. We collected information on respondents' willingness to participate in wetlands restoration program before and after them watching the education video, as well as farmers' demographics and other socio-economic variables to identify factors influencing the effect of the environmental education program. The positive information effect found in our studies provides important policy implications to the government that

educational programs or campaigns will effectively increase farmer's willingness to participate in wetlands ecosystem restoration.

Methodology

In this study we first compare the information treatment effect using the paired t-test as well as the propensity score matching approach. We also use the ordered Probit model to test the information effect and identify factors affecting farmer participation. We will further investigate what factors determine the effect of information treatment with a Probit model.

Ordered Probit Model

Let y_i be the ordered response of farmer's willingness to participate in wetland restoration, which is of our interest to explain. To capture the nature that order of response matters, an ordered probit model is estimated. Following Wooldridge (2001), y_i is assumed to be generated by the underlying linear latent variable model,

$$y_i^* = \boldsymbol{x_i}\boldsymbol{\beta} + e_i \qquad e_i|\boldsymbol{x_i} \sim N\ (0\ ,\ 1\ ). \tag{1}$$

The random term *e* is assumed to follow a standard normal distribution with mean zero and variance one. Let $\alpha_1 < \alpha_2 < \cdots < \alpha_J$ be J unknown cut points, which will be estimated along with $\boldsymbol{\beta}$. Assume

$$\begin{aligned}
&y_i = 0 \text{ if } y_i^* \leq \alpha_1 \\
&y_i = 1 \text{ if } \alpha_1 < y_i^* \leq \alpha_2 \\
&\qquad \vdots \\
&y_i = J-1 \text{ if } \alpha_{J-1} < y_i^* \leq \alpha_J \\
&y_i = J \text{ if } y_i^* > \alpha_J.
\end{aligned} \tag{2}$$

Then, it is easy to obtain the probability for each willingness-to-participate response category:

$$P(y_i = 0|\boldsymbol{x_i}) = P(\boldsymbol{x_i\beta} + e_i \leq \alpha_1|\boldsymbol{x_i}) = \Phi(\alpha_1 - \boldsymbol{x_i\beta})$$

$$P(y_i = 1|\boldsymbol{x_i}) = P(\alpha_1 < \boldsymbol{x_i\beta} + e_i \leq \alpha_2|\boldsymbol{x_i}) = \Phi(\alpha_2 - \boldsymbol{x_i\beta}) - \Phi(\alpha_1 - \boldsymbol{x_i\beta})$$

$$\vdots$$

$$P(y_{J-1} = 1|\boldsymbol{x_i}) = P(\alpha_{J-1} < \boldsymbol{x_i\beta} + e_i \leq \alpha_J|\boldsymbol{x_i}) = \Phi(\alpha_J - \boldsymbol{x_i\beta}) - \Phi(\alpha_{J-1} - \boldsymbol{x_i\beta})$$

$$P(y_J = 1|\boldsymbol{x_i}) = P(\boldsymbol{x_i\beta} + e_i > \alpha_J|\boldsymbol{x_i}) = 1 - \Phi(\alpha_J - \boldsymbol{x_i\beta}). \quad (3)$$

The associated log-likelihood function is maximized to solve for the parameters $\boldsymbol{\beta}$:

$$l_i(\boldsymbol{\alpha}, \boldsymbol{\beta}) = 1[y_i = 0]log[\Phi(\alpha_1 - \boldsymbol{x_i\beta})]$$

$$+1[y_i = 1]log[\Phi(\alpha_2 - \boldsymbol{x_i\beta}) - \Phi(\alpha_1 - \boldsymbol{x_i\beta})]$$

$$+ \cdots + 1[y_i = J]log[\Phi(\alpha_J - \boldsymbol{x_i\beta}) - \Phi(\alpha_{J-1} - \boldsymbol{x_i\beta})] \quad (4)$$

Data

In-person interviews were conducted in the Poyang Lake region in 2014. The survey was administered by the China Agricultural Survey Service Jiangxi Field Office. Participating farm households are randomly sampled in the wetlands and neighboring area and 1009 observations were collected. The question of farmers' willingness to participate is measured in a 5-point Likert scale (with 1 indicating extremely not willing to participate, 2 indicating not willing to participate, 3 indicating indifferent, 4 indicating willing to participate and 5 indicating extremely willing to participate). Table 1 presents the summary statistics of variables.

Table 1: Summary Statistics of Variables

Variables	**Units**	**Obs**	**Mean**	**Std. Dev.**
Pre- treatment willingness	Likert: 1-5	1009	3.792	0.744
Post-treatment willingness	Likert: 1-5	1009	4.549	0.604
Age	Years	1009	44.90	11.79
Gender	Binary	1009	0.75	0.43
Education	Likert: 1-5	1009	2.71	1.24
Household size	Persons	1009	5.19	1.38
Number Children	Persons	1009	0.93	0.83
Number Seniors	Persons	1009	0.88	0.82
Number Agricultural Laborers	Persons	1009	1.75	0.95
Migrant Labor Days	days	1009	262.95	437.11
House Value	10,000 RMB	1008	9.36	6.39
Household Income	10,000 RMB	1009	5.33	5.40
Cropping Income	Ratio	1006	0.22	0.25
Farmland Size	mu	1009	4.59	4.91
Distance to County Seat	kilometers	1009	23.83	16.94

To capture the potential information effect on farmers' decisions to participate, a 16-minute video regarding wetlands ecosystem was introduced in the survey. The video explains what wetlands are

and how they affect environment, wildlife, and climate. The video also shows land reclamation and wetlands destruction in the Poyang Lake area. During the interview, farmers were first asked whether or not they are willing to participate in wetlands restoration. Then they were invited to watch the educational video about wetlands. After that, the survey interview session was resumed and farmers were asked to answer additional questions and report their willingness to participate again.

Results (Table 2) indicate that, on average, farmers' willingness to participate is between "indifferent" and "willing" to participate before watching the video, while it is between "willing" and "extremely willing" after watching it. The willingness is significantly improved by one level. The paired t-test statistic is 42.067 and is statistically significant at the 1% significance level.

Table 2. Paired T-test results for mean comparison between pre- and post-treatment willingness

Variable	**Observations**	**Mean**	**Standard Error**
Post-willingness to participate	1009	4.549	0.019
Prior-willingness to participate	1009	3.792	0.023
Difference	1009	0.757	0.018
$\boldsymbol{H_0}$: Mean (Difference)=0		t=42.067 (p-value=0.000)	
		Degree of freedom =1008	

As all survey respondents were invited to watch the educational video about wetlands, we are in an ideal setting to directly compare how farmer's willingness to participate in wetlands restoration may change after obtaining information about wetlands. The paired t-test is used to examine the mean differences of individual farmer's pre- versus post-treatment willingness to participate.

This mean difference captures the average treatment effect of information on farmer's willingness to participate that we are interested in. The propensity score matching (PSM) method, which is a standard approach to estimate treatment effect, is also implemented to compare with the paired t-test results. As all survey respondents were invited to watch the educational video about wetlands, we do not have a control group. Given that information on both pre- and post-treatment willingness to participate is available, we stacked the post-treatment sample to the pre-treatment one, resulting in a new sample (doubled sample size to 2018), in which an identical person appears twice for each individual farmer. Each individual farmer in the control group is then distinguished from his identical in the treatment group by a binary indicator of treatment. A new dependent variable "willingness to participate" is constructed which equals to pre-treatment willingness to participate for the control group (i.e., treatment indicator=0) and equals to post-treatment willingness to participate for the treatment group (i.e., treatment indicator=1). The results from the propensity score matching method (PSM) is summarized in Table 3.

Table 3. Average Treatment Effect (ATE) Estimated from Propensity Score Matching Method

	Observations	**Coefficient**	**Standard Error**
ATE of Information	2018	0.757	0.030
$\boldsymbol{z}$ ($\boldsymbol{p}$-value)		25.61 (0.000)	

Control variables used for the treatment model include age, gender, marriage, education, household size, number of children, number of seniors, number of agricultural labor, house value, cropping income, household income, farmland size, and the distance to the county seat. However, the set of control variables does not matter because this information is the same as the treatment and control groups are identical. The estimated coefficient of the treatment effect is the same as long as all information are used (i.e., there are no missing observations in the control variables).

As the focal point of the paired t-test and the propensity score matching (PSM) method is to compare the before- and after-effect of introducing an educational video, these two methods provide the most efficient estimates of the information effect on farmer's willingness to participate. However, they provide no additional information on how other factors may affect individual farmer's willingness to participate in wetlands restoration. We conducted an ordered Probit and a binary Probit analysis to further investigate how individual farmer characteristics and/or farmer household attributes may affect farmer's willingness to participate *and* the information treatment, respectively.

Factors Affecting Willingness to Participate: Ordered Probit Regression

The data structure used for the ordered Probit regression analysis is the same as what were used for the propensity score matching (PSM) method.[1] The key explanatory variable is the binary indicator of treatment which distinguishes the pre-treatment sample (without watching the educational video about wetland) from the post-treatment repeated sample (watching the educational video) with the dependent variable "willingness to participate" equal to pre-treatment willingness to participate (i.e., treatment indicator=0) and to post-treatment willingness (i.e., treatment indicator=1), respectively.

[1] You can also randomly divide the original sample of 1009 observations into two groups. But doubling sample size is preferred to dividing sample size because the latter uses only half of the information.

Individual and household characteristics are included in the regression to identify their effects on farmers' willingness to participate in addition to information. An ordered probit model is estimated and reports are summarized in Table 4. As expected, information has significantly positive effect on farmer's willingness to participate. In addition, we also find that gender, number of seniors in the household and number of migrant days away from home are positively associated with farmers' willingness to participate while number of agricultural laborers in the household and farmland size are negatively associated with farmers' willingness to participate.

Table 4. Estimated Coefficients from Ordered Probit Model

Explanatory Variable	Dependent variable: Willingness to participate	
	Ordered Probit	
	Coefficient	Standard Error
Information	1.376***	(0.063)
Age	-0.002	(0.003)
Gender	0.147**	(0.064)
Education	0.021	(0.027)
Household Size	0.006	(0.025)
Number Children	0.016	(0.037)
Number Seniors	0.113***	(0.035)
Number Agricultural Laborers	-0.081***	(0.031)
Migrant Labor Days	0.0002***	(0.000)
House Value	0.003	(0.004)
Household Income	0.009	(0.006)

Cropping Ratio	0.033	(0.071)
Farmland Size	-0.015**	(0.007)
Distance	0.001	(0.002)
Cut 1	-2.028	(0.234)
Cut 2	-1.297	(0.212)
Cut 3	-0.505	(0.209)
Cut 4	1.344	(0.211)
No. of Observations	1,924	
Prob>chi^2	518.32	
Pseudo R^2	0.154	
Log likelihood	-1754.483	

Notes: 1. Robust standard errors are reported in parentheses. 2. "*", "**" and "***" represent significance level at 10%, 5% and 1% respectively

Factors Affecting Information Effect: Binary Probit Regression

To further explore what factors are driving the information effect, we utilize the entire sample in the binary Probit model. We take differences between farmer's pre- and post-treatment willingness to participate and regress the willingness on individual and household characteristics. This difference in willingness to participate measures individual farmer's change of attitude after treatment (i.e., watching an educational video). As shown in Table 5, while the majority of the farmer respondents (734 out of 1009 farmers) are positively affected after watching the educational video, there are 8 farmers (less than 1%) are actually adversely affected after receiving information about wetlands, i.e., these eight farmers somehow become less willing to participate in wetlands restoration after

watching the video. 267 farmer (26.5%) reported no change of willingness to participate after watching the video(See Table 5 for details).

Table 5: Change of Willingness-to Participate Attitude

Difference		Number of Observations	Percentage (%)	
	-4	1	0.10	
Negative change	-3	1	0.10	0.79
	-1	6	0.59	
No change	0	267	26.46	26.46
	1	698	69.18	
Positive change	2	29	2.87	72.74
	3	7	0.69	
Total		1,009	100.00	100.00

To identify factors affecting the information effect a binary variable is generated to categorize the direction of farmers' willingness change with one indicating positive change of attitude and zero indicating a non-positive change of attitude. Using this binary variable as a dependent variable measuring the information effect, a Probit model is then estimated to examine how other factors may also affect farmer's change of willingness to participate.[2]

[2] Authors also experimented with ordered Probit model by further dividing "non-positive change of attitude" into no change of attitude (0) and negative change of attitude (-1). Consistent results are obtained and are available from authors upon request.

Table 6. Estimated Coefficients and Marginal Effects from Probit Model

Explanatory Variable	Dependent variable: Attitude change of willingness to participate *(1 = positive attitude change, 0 = non-positive attitude change)*	
	Probit	
	Coefficient	Marginal Effects
Age	-0.009**	-0.003**
	(0.004)	(0.001)
Gender	0.193*	0.062*
	(0.102)	(0.003)
Education	-0.009	-0.003
	(0.041)	(0.013)
Household Size	-0.062*	-0.020
	(0.042)	(0.013)
Number Children	0.054	0.017
	(0.060)	(0.019)
Number Seniors	-0.023	-0.007
	(0.061)	(0.019)
Number Agricultural Laborers	-0.023	-0.007
	(0.050)	(0.016)
Migrant Labor Days	0.000	0.000
	(0.000)	(0.000)
House Value	0.012*	0.004*
	(0.007)	(0.002)

Household Income	-0.015**	-0.005**
	(0.008)	(0.002)
Cropping Ratio	-0.219*	-0.070*
	(0.128)	(0.041)
Farmland Size	-0.004	-0.001
	(0.010)	(0.003)
Distance	-0.007***	-0.002***
	(0.003)	(0.001)
Constant	1.405***	-
	(0.319)	-
No. of Observations	962	
Prob>chi^2	0.000	
Pseudo R^2	0.312	
Log likelihood	- 546.69	

Notes: 1. Robust standard errors are reported in parentheses. 2. "*", "**" and "***" represent significance level at 10%, 5% and 1% respectively

Results from the Probit model is summarized in Table 6. We find that age, household size, household income, ratio of agricultural income to total household income and distance to the county seat are negatively associated with farmer's change of attitude. In other words, a farmer is less likely to be affected by information when he is older, running a larger household in a more remote area and having higher household income or higher agricultural income. On the other hand, a male farmer or a farmer who has higher property value of house is more likely to be positively affected

by information and become more willing to participate in wetlands restoration. Our results have important policy implications for the government to increase wetland restoration activities through provision of information and farmer education.

Conclusions and Discussions

In this study we developed an educational video to educate farmers about wetlands and their environmental and socio-economic functions in an experiment to investigate the impact of information treatment on farmers' willingness to participate in wetlands restoration program. We found significant positive information effect on the program participation. The finding suggests that government educational program could effectively enhance farmer participation in the wetlands restoration program. We further found that age, farm household size, and distance to county seat, and household income negatively impact information effect, while being a male farmer and property value positively have a positive effect. Our results have important policy implications for the government to enhance wetland restoration participation through provision of information and farmer education.

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Appendix: Variable Definitions:

Variable Name	Definition
Pre-willingness to participate	5-point Likert scale, 1 if extremely not willing to participate, 2 if not willing to participate, 3 if indifferent, 4 if willing to participate, 5 if extremely willing to participate
Post-willingness to participate	5-point Likert scale, 1 if extremely not willing to participate, 2 if not willing to participate, 3 if indifferent, 4 if willing to participate, 5 if extremely willing to participate
Age	farmer's age in years.
Male	binary, 1 if male, 0 otherwise
Education	education level, 1 if illiterate, 2 if primary school, 3 if middle school, 4 if high school, 5 college and above.
Household Size	number of people in the household
Number Children	number of children under age 15 in the household
Number Senior	number of senior dependents in the household
Number Agricultural Laborers	number of available agricultural laborers in the household
Migrant Labor Day	Number of days working as a migrant labor working out of home town
House Value	estimated house property value (10,000 RMB)
household Income	total net household income (10,000 RMB).
Cropping Ratio	proportion of income from cropping to net household income
Farmland Size	farmland acreage owned or managed (mu)
Distance	distance to the county seat (kilometers)