Research Article
Ecological Compensation Mechanism of Agricultural Water Resources: An Empirical Study in Zhejiang, China

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Abstract: Ecological compensation is a new area in the field of resources environment. In this study, we set an empirical analysis model about ecological compensation mechanism and analyze influential factors based on agricultural perspective. The result shows that: first, loss of development opportunities is the most important factor that will affect ecological compensation, the regression coefficient is 0.071; sec, environmental protection cost is the most significant variable in ecological compensation, the sig value is 0.007 and the regression coefficient is positive; third, public awareness has high coefficient value as 0.048, means that public awareness plays a positive effect. Overall, the regression model of the empirical results with the above assumptions, under the 10% significant level, the loss of development opportunities; environmental protection cost; the compensation standard; public awareness of the value of ecological environment variable are significantly variables that affecting ecological compensation and the effects of other variables are not obvious. On this basis, we put forward relevant suggestions.

Keywords: Ecological compensation, economy benefit, public awareness, water resources

INTRODUCTION

In recent years, the shortage of water resources, the deterioration of water environment, water emergency has been profoundly endanger the safety of water supply China city (Chen and Zhou, 2014). In order to ensure sufficient supply of water resources, reduce water pollution, China has established a lot of water area and these areas are usually also is an important ecological barrier area and relatively poor regional economic (Luz *et al.*, 2013). In order to safeguard the safety of ecosystem, the basin to ensure the sustainable utilization of the water resources, the state restrictions on development and protection of the products and industrial development (Georg and Lanz, 2008), reserve sacrificed some opportunities and economic interests, further widening the gap between the social and economic development in the downstream area. Ecological compensation is a new area in the field of resources environment. Generally, eco compensation for the water source area is materialized by the behavior of the beneficiaries in the catchments area who use the water resources and its ecosystem services and pay some form of compensation to the protector in the water supply region (Parikshit and Steven, 2014). As the eco-compensation mechanism has been put into the national agenda, eco-compensation of water source is becoming the priority area of our concern (Qing and Li, 2013). So setting up the eco-compensation mechanism of water source is extremely urgent.

The original meaning of ecological compensation is a naturalistic explanations, its connotation is defined

as the organism, population, community or disturbances are shown when the mitigating interference, adjust its state to maintain the survival ability and can be regarded as the reduction ability of ecological load. Ecological compensation is known as the ecological compensation Payments for Ecosystem Services (PES) or Payment for Ecological Benefit (PEB), a provider of payment is the behavior of environmental service function of ecological beneficiaries. Ana and Jordi (2013) pointed out that ecological compensation is defined as: in order to improve the environmental quality of the damaged area or to create new with similar ecological functions and environmental quality in the area of a subsidy ["in the development of the ecological function and quality caused by the damage. Mampiti and Hassan (2006) pointed out payment for environmental services for the protection of the ecological environment control means, is an alternative to control, based on the means of the market economy. Laurence *et al.* (2012) believes that ecological compensation is a kind of ecological environmental compensation, in order to control the ecological damage and the collection of fees, the nature is the external cost behavior, the purpose is to make the collection the internalization of external costs; Zhang and Liu (2010) consider ecological compensation as the ecological environment of the natural resources value compensation, that is to levy ecological compensation effect for reducing the damage to the ecological environment of economic stimulus. From the

perspective of the institution economics, the mechanism is a kind of system arrangement in order to achieve a goal, is a system of procedures, rules and method system (MinHyeok and Park, 2014).

The water resources ecological compensation is an important aspect of basin ecological compensation, the compensation is to establish fair and reasonable incentive mechanism, to restore (Li, 2014), maintain and improve the water ecosystem service function, so that the whole basin can play the best benefit of integral (Dohyeong and Yang, 2014). Ecological compensation mechanism of water resources in the internalization of external costs for the same principle is based on the protection of the water source area protection act upstream of the external economic, ecological service function to improve the payment cost of the ecological protection and development opportunities, to sacrifice the cost (Zhou, 2013; Li, 2012). From the present research and practice of the domestic and international situation, the water resources ecological compensation mainly in favor of downstream water resources consumption and use of ecosystem service function in the form, in the relevant laws and regulations and system, pay some form of compensation to the water source area of the protector, which belongs to a gain compensation (Anne and Levrel, 2013).

At present, the academic circles on the impact of ecological compensation mechanism in China can be described as a factor of less and less. Only a few scholars discussed the establishment of ecological compensation mechanism. Timothy and William (2005) conclude five main factors of river basin ecological compensation mechanism in China and establish the scientific evaluation system as technical level, legal level, ethical level, management level and funding level. Ning and Li (2013) believes that the measurement of critical evaluation and compensation standard of ecological value, but it is not a good standard and evaluation method. It is undeniable that reasonable legal system is the premise and basis for the ecological compensation (Robert, 2014), but the current laws and regulations of our country cannot meet the actual needs of the new situation of ecological compensation. Li (2013) analyzes the obstacle factors of ecological compensation in China from the perspective of law, the obstacle factors including four aspects as the concept barriers, technical barriers, management barriers, laws and regulations barriers. Vijay and Adamowski (2014) believes that to strengthen the ecological compensation, we should internalized into people's conscious behavior and establish river basin ecological compensation system to provide the support of public opinion and social security; to determine the compensation standard is one of the difficult problems of valley ecological compensation system in each department; act of one's own free will, which prevents the centralized management and to improve the efficiency of the use of funds.

MODEL DESIGE AND STATISTICAL ANALYSIS

Model construction and variables: On the basis of comprehensive analysis on the influencing factors, the mechanism of ecological compensation mechanism of water resources can be expressed as:

$$Y = F(X_A, X_B, X_C, X_D, Z) \qquad (1)$$

In this formula,
Y = The result of the ecological compensation
X_A = Cost of protection
X_B = Ecological compensation elements
X_C = Management system
X_D = Public awareness
Z = Dummy variables as Legal policy

Let Y denote the ecological compensation decision making results (Y = 1 means compensate, Y = 0 means not compensate), Xi represents the factors (i = 1, 2,…, I), then the formula can be further expressed as:

$$Y = \sum \beta_i x_i + \alpha \qquad (2)$$

Among them, the beta I represents Xi changes on ecological compensation the influence degree of probability; Alpha as independent random errors, meet with mean zero, variance of 1 standard normal distribution, it represents some of the potential not observed variables and data error; Formula (2) an empirical analysis is the study of application of econometric model. Based on analysis, this study examine variables to make the following choice, refer to the related research and the coefficient of symbols make the assumption, as shown in Table 1.

Further, for this kind of phenomenon of binary discrete quantity analysis, this study adopts the binary logistic model to analyze ecological compensation decision-making, in order to more objectively analyze the effect of various influence factors of ecological compensation, a more accurate measure its impact. Remember the conditional probability of the incident P (y = 1 | xi) = Pi, can get the following logistic return model:

$$p_i = \frac{1}{-\left(\alpha + \sum_{i=1}^{m} \beta_i x_i\right)} = \frac{e^{\alpha + \sum_{i=1}^{m} \beta_i x_i}}{1 + e^{\alpha + \sum_{i=1}^{m} \beta_i x_i}} \qquad (3)$$

$$1 - p_i = 1 - \frac{e^{\alpha + \sum_{i=1}^{m} \beta_i x_i}}{1 + e^{\alpha + \sum_{i=1}^{m} \beta_i x_i}} = \frac{1}{1 + e^{\alpha + \sum_{i=1}^{m} \beta_i x_i}} \qquad (4)$$

Table 1: The main variables

Variables	Secondary variables	Meaning	Code
Cost of protection β1	The loss of development opportunities	Development opportunities in order to save water resource and los	X1
	Environmental protection cost	The cost of investment in environmental protection	X2
	Ecological restoration cost	Ecological restoration and management cost	X3
Ecological compensation elements β2	The compensation standard	Measurement technology of ecological compensation standard	X4
	Compensation method	Ecological compensation offered by the government or policy	X5
	The compensation methods	Use of funds in the process of ecological compensation	X6
Management system β3	Standardization	Compensation procedures and government management	X7
	Department cooperation	Achieve the coordination between departments	X8
Public awareness β4	Public awareness of the value of ecological environment	The public think that the protection of ecological environment is important	X9
	Willingness to accept compensation	Whether the public to carry out activities to ecological compensation	X10
	The public participation	Whether the public to actively participate in the activities of the ecological compensation	X11
Dummy variables as Legal policy D		Whether the establishment of the relevant laws and regulations system	X12

Table 2: Statistical analysis of questionnaire participants' basic characteristic

Personal characteristics	Min.	Max.	Average	S.D.
Age	17	59	32.62	8.235
Disposable monthly income	0	20000	2104.76	3162.579

Min.: Minimum; Max.: Maximum; S.D.: Standard deviation

Table 3: Occupation and education background analysis of questionnaire participants

	Classification	Number	Percentage	Effective percentage	Cumulative percentage
Occupation	Civil servants	17	12.23	12.23	12.23
	Enterprise staff	34	24.46	24.46	36.69
	Business and service personnel	56	40.28	40.28	76.97
	Students	20	14.38	14.38	91.35
	Others	12	8.65	8.65	100
Education	High school	25	17.98	17.98	17.98
	Undergraduate	68	48.92	48.92	66.91
	Graduate	46	33.09	33.09	100
	Total	139	100	100	

In this formula, Pi representatives the probability of events as observation i, 1-Pi represent in the probability of events does not occur, they are all made of the independent variable xi nonlinear function. The ratio of the incidence of the incident and Pi/(1-Pi) referred to as the occurrence of the event, for the Odds. Odds have no upper bound and positively (0<Pi<1), the logarithmic transformation of logistic linear model can be shown as:

$$\mathrm{Ln}\left(\frac{p_i}{1-p_i}\right) = 1 - \frac{e^{\alpha+\sum_{i=1}^{m}\beta_i x_i}}{1+e^{\alpha+\sum_{i=1}^{m}\beta_i x_i}} = \frac{1}{1+e^{\alpha+\sum_{i=1}^{m}\beta_i x_i}}$$

(5)

Data sources and sample: This study taking 2014 July to September as the survey time period, whether city residents participated in the study of ecological compensation. The author choose Hangzhou city of Zhejiang province as the main sampling area to urban residents, as the investigation object, a population is more concentrated large supermarkets, shopping malls and mainly residents near the river for the survey locations, by field questionnaire survey, 200 questionnaires were distributed, recovery of 167 copies, out no answer or reply invalid questionnaire 28 is not correct, effective questionnaire 139, effective questionnaire rate was 69.5%.

RESULTS AND DISCUSSION

Statistical analysis: From the survey of the residents in the whole, the participation of urban residents in the ecological compensation age trend was younger (average age 32.62 years), with higher disposable monthly income (2104.76 RMB), as shown in Table 2. In occupational composition, this investigation has object with civil servants (12.23%), Enterprise staff (24.46%) and Business and service personnel (40.28), students (14.38). The cultural degree, college degree above investigation residents total ratio reached 82% (among them, college education accounted for 48.92%, graduate education accounted for 33.09%) and a high school diploma is only 17.98%, which fully shows that the potential demand of ecological compensation reflect the characteristic of high degree, positive correlation between the degree of education and ecological compensation. As shown in Table 3.

Table 4: The model of goodness of fit evaluation

	Hosmer and Lemeshow Test			Model summary		
Step	Chi-square	df	Sig.	-2Loglikelihood	Cox and Snell R2	Nagelker ke R2
1	5.723	6	0.756	62.568	0.514	0.704

Table 5: The results of regression model

	Explanatory variables	Model 1. (Enter) Step 1 (n.)				Model 2. (backward: condition method) Step2 (b.)				
		B	S.E.	Wald	Sig.	B	S.E.	Wald	Sig.	Exp(B)
β1	X1	0.001	0.002	4.316	0.015	0.000	0.000	3.156	0.071	1.014
	X2	0.015	0.004	5.025	0.024	0.017	0.006	6.068	0.007	0.890
	X3	0.003	0.005	3.115	0.058					
β2	X4	-0.028	0.026	2.753	0.067	-0.029	0.017	3.042	0.058	0.914
	X5	0.049	0.031	1.795	0.118					
	X6	0.003	0.017	2.562	0.069					
β3	X7	0.027	0.018	2.454	0.096	0.043	0.021	4.796	0.026	1.058
	X8	0.015	0.028	1.250	0.014					
β4	X9	1.147	0.651	2.623	0.001	1.236	0.059	3.203	0.048	3.015
	X10	0.158	0.704	0.035	0.872					
	X11	0.246	0.572	0.682	0.391					
Constant		-8.14	2.76	9.25	0.005	-5.029	1.65	8.132	0.007	0.005

S.E.: Standard error

The goodness of fit analysis in the model: According to the output analysis, fitting statistics (Hosmer and Lemeshow Test) values ($\rho = 0.756$)>0.05, unable to reject the null hypothesis, shows the probability to obtain the expected frequency and there was no statistically significant difference between the observed frequency, namely survey data model fitting is good, as shown in Table 4. The final test of goodness of the model is 62.568, Model of the fit of the data is more ideal; the following reference Nagelkerke R2 statistic a value as 0.704, data also shows that a better fitting effect.

The results of regression model: Residents having willingness to make ecological compensation is essentially a dichotomous variable. The dependent variable value range of the traditional regression model between is infinite and negative infinity, in this apparently doesn't fit, so this study uses the binary Logistic regression analysis model is analyzed and using the maximum likelihood estimation method is used to estimate the parameters. This study uses SPSS17.0 statistical software for survey data processing, first choose forced into law, will have to examine variables one-time into the Logistic regression model analysis, it is concluded that model 1; After the second choice to gradually selection method, will examine all variables in the regression model analysis, investigation variables significantly model 2, as shown in Table 5.

The result shows that: first, loss of development opportunities is the most important factor that will affect ecological compensation, the regression coefficient is 0.071; sec, environmental protection cost is the most significant variable in ecological compensation, the sig value is 0.007 and the regression coefficient is positive; third, compensation standard

variables' sig value is less than 0.1, the regression coefficient value is -0.029, probably because the city residents to participate in the study area of ecological compensation is more focus on the cost and less attention on the measurement technology of ecological compensation standard; finally, the public awareness has high coefficient value as 0.048, means that public awareness plays a positive effect. Overall, the regression model of the empirical results with the above assumptions, under the 10% significant level, the loss of development opportunities; environmental protection cost; the compensation standard; public awareness of the value of ecological environment variable are significantly variables that affecting ecological compensation and the effects of other variables are not obvious.

CONCLUSION

Based on the theoretical analysis, this study sets an empirical analysis model about ecological compensation mechanism of agricultural water resources and analyzes influential factors. The result shows that: first, loss of development opportunities is the most important factor that will affect ecological compensation, the regression coefficient is 0.071; sec, environmental protection cost is the most significant variable in ecological compensation, the sig value is 0.007 and the regression coefficient is positive; third, compensation standard variables' sig value is less than 0.1, the regression coefficient value is -0.029, probably because the city residents to participate in the study area of ecological compensation is more focus on the cost and less attention on the measurement technology of ecological compensation standard; finally, the public awareness has high coefficient value as 0.048, means that public awareness plays a positive effect. Overall,

the regression model of the empirical results with the above assumptions, under the 10% significant level, the loss of development opportunities; environmental protection cost; the compensation standard; public awareness of the value of ecological environment variable are significantly variables that affecting ecological compensation and the effects of other variables are not obvious. On this basis, we put forward relevant suggestions.

First of all, government should improve the responsibility mechanism of ecological compensation. The responsibility mechanism of water resources ecological compensation is to determine the identity and responsibilities (Li and Ning, 2012), which is related to the main responsibility according to different ecological compensation liability, its principle namely clear who compensate whom problem. According to the analysis results, the subject and object of compensation is the core element of the system and also the ecological compensation elements. So, the subject and object of water resources ecological compensation should be clearly defined. Secondly, we can learn from the foreign experience, establish and perfect the public participation mechanism, enhance the management of water resources ecological compensation institution shall strengthen the information disclosure and the protection of public participation in the right to know; at the same time, held on a regular basis of ecological protection, ecological compensation in water source area of publicity and education activities, strengthen the citizen's environmental protection consciousness and awareness of compensation

Finally, the government played a leading role in the establishment and improvement of ecological compensation laws and regulations, the government is a dominant force in the establishment of ecological compensation mechanism (Zhou and Qing, 2013). The macroeconomic regulation and control of resources and environment issues, funding and policy support, laws and institutions, the market cannot solve the problem of spontaneous government needs to play a leading role. The government and various departments to raise awareness, unity of thinking, strengthen leadership, sound speed up water resources ecological compensation mechanism. By improving watershed management institutions, government promotes the work of ecological compensation and ecological construction. The establishment of ecological compensation mechanism need further development and reform, we need environmental protection, land resources, forest, water, construction, economy, agriculture and other departments actively cooperate with, at the same time, governments at all levels should introduce relevant ecological compensation policies, strengthen financial management and rational funding use.

ACKNOWLEDGMENT

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