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论文题目：A Survey Analysis on Rural Environment Governance

A Survey Analysis on Rural Environment Governance

Abstract

Currently, rural environmental pollution has been a great concern in China. However, existing research has mainly focused on the responsibilities of the government and seldom discussed the importance of the grassroots level. Based on the survey data from Chinese Thousand Village Survey in 2018, this paper shows that raising the environmental consciousness of villagers and village committees can significantly improve the ecological environment of the area, as people will transform the recognition of the green concept into action. However, the essay finds that the influence of people's environmental consciousness is limited to domestic pollution and has little effect on enterprise or agricultural pollution which are closely connected to economic profit.

***Key words**:* Environmental governance, Environmental pollution, Rural development

Content

1 Introduction

Over the past forty years of economic reform, China has witnessed rapid economic growth and huge improvement in the living standards of its residents, but meanwhile, the economic growth has brought about serious environmental pollution. For example, some rural areas with weak environmental supervision have become gathering places for high-polluting companies operating in violation of regulations. Therefore, rural pollution has become a great concern for Chinese government. In 2015, the Chinese government initiated the five development concepts of "innovation, coordination, green, openness, and sharing" to deal with the conflict between economic development and environmental protection in villages. In China's "14th Five-Year Plan and 2035 Long-Term Goals Outline" announced in March 2021, it is also proposed to "carry out improvements on people's living condition and environment in villages." Therefore, in this context, the analysis of village ecological environment governance has great practical significance.

To strengthen environmental protection, it is useful to diversify the ways of governance. Previous studies and government measures have focused on the role of government departments (Li Yongmei, 2015). With the continuous advancement of government policies, low awareness of eco-friendly development of village committees and villagers has limited the progress of environmental protection (Huang Senwei et al., 2017; Du Xi, 2018). Nevertheless, only a small number of previous studies paid attention to the role of the grassroot entities (Li Yongmei, 2015), and they did not further analyze the impact of governance mechanisms. Thus, it is of great realistic significance for this essay to analyze how the attitudes of villagers can affect the protection of environment.

2 Literature Review and Theory

While sustainable development plays an important leading role in the current village governance, scholars have different opinions regarding who is responsible for it. Most scholars believe that because the village ecological environment is a kind of public goods, which is distinctly non-competitive and non-exclusive, the government should take the most responsibility (Lou Shuwang, 2016; Feng Yangxue and Xu Kun, 2017; Yan Xifeng, 2020). Some have emphasized the responsibility of enterprises: due to the ineffective supervision in rural areas, enterprises will spoil the environment for profit, so they propose to regulate the actions of factories (Zhang Zhisheng, 2020). Peng Xiaoxia (2016) discussed the importance of community participation and support the enactment of relevant laws and public participation mechanism.

Currently, in the management of pollution, China employs a "top-down" management mode led by the government (Jin Taijun and Xue Ting, 2020), which has led to many progress. However, this mode also makes the ecological environment governance rights and responsibilities too centralized, thus weakens the roles of other entities (Li Yongmei, 2015). It is also important for the government to lead other subjects to participate in the environmental governance of the village to form a

governance synergy (Zhan Guobin and Chen Jianpeng, 2020). In view of this reality, some scholars, referring to the meta-governance theory (Jessop, 1997), emphasizes that the government should act as the "elder of the same generation" in the governance process, instead of the previous "state-centered theory". The theory highlights the government's cooperation with other entities besides its direct governance. (Tang Renwu and Li Cheng, 2014; Qu Yanchun, 2021).

The research contributions of this paper are the following:

1. With the survey data of thousands of villages, the paper explores, in protecting the environment, whether it is useful to raise the environmental awareness of village committees and villagers. It provides empirical evidence for strengthening the propaganda of green development and giving full play to the main role of the village committee and villagers in the governance of the village's ecological environment.

2. Explore the differences in ecological environment governance methods between villages due to different main pollution sources, and analyze its possible causes. This provides a reference for each region to choose appropriate ecological environmental governance measures based on pollution sources and local conditions.

We make the following two hypothesis:

Hypothesis 1: The environmental awareness of village committees is conducive to improve the village's ecological environment.

Village committees undertake the task of handling the village's public affairs and the construction of public facilities. If they pay attention to environmental protection, they will be able to carry out the construction of certain facilities such as sewage plants and strengthen local supervision on pollution based on the circumstance of the villages. Therefore, the environmental awareness of village committees will have a certain impact on the village's ecological environment construction.

Hypothesis 2: Increasing villagers' environmental awareness can improve the village's ecological environment.

Villagers are not only the victims of the village's ecological environment pollution, but also the beneficiaries of the improvement of the village's ecological environment, so they could have a strong motivation to protect the environment around them. It can also be seen from the actual situation that the overall environmental protection awareness of Chinese villagers is weak, and they do not understand and pay little attention to environment protection. This has become an important factor impeding the current village ecological environment construction (Yu Fawen, 2021).

Some studies have shown that villagers' awareness of environmental protection has a significant impact on the ecological environment. For example, Wang Huogen (2020) found that farmers' awareness of environmental protection has a positive effect on the utilization of agricultural waste; Liu Miaoling et al. (2014) also found a strong positive correlation between villagers' cognitive ability of environment and their treatment of pesticide waste. Therefore, we believe that changes in the villagers' attitudes toward environmental protection have impact on ecological environment.

3 Raw Data and Basic Analysis

The data in the essay is based on Chinese Thousand Village Survey (CTVS) in 2018 conducted by Shanghai University of Finance and Economics, whose topic is "The status of rural ecological civilization construction". The questionnaires of the investigation are consisted of two parts: (1) Village questionnaire for the overall situation of the village. The main subjects are those responsible for village management and development, such as the village party secretary or village chief. (2) farmer questionnaire for the situation of farmer households. The subject is the head of a farm household (Su Fang and Fang Lei, 2016; Yang Chan and He Xiaogang, 2019).

The data in this study are mainly derived from village questionnaires: a total of 757 village questionnaires. The survey area covered 31 provinces, municipalities and autonomous regions except Hong Kong, Macao and Taiwan. The regional distribution of the villages interviewed is shown in Table 1. Among them: 300 villages in East China, accounting for 39.63% of the total; 118 villages in Central China, accounting for 15.59% of the total; 116 villages in Southwest China, accounting for 15.32% of the total; 34 villages in South China and North China respectively (4.49%) and 82 (10.82%); the villages in the northwest and northeast regions are 67 (8.85%) and 40 (5.28%) respectively.

Table 1 Regional distribution of interviewed villages

Area	Number	Percentage of total (%)	Province	Number	Percentage of total (%)
East China	300	39.63	Shandong	54	7.13
			Jiangsu	60	7.93
			Anhui	51	6.74
			Zhejiang	46	6.08
			Fujian	10	1.32
			Shanghai	79	10.44
Northwest China	67	8.85	Ningxia	10	1.32
			Xinjiang	23	3.04
			Qinghai	4	0.53
			Shaanxi	16	2.11
			Gansu	14	1.85
Southwest China	116	15.32	Sichuan	31	4.10
			Yunnan	30	3.96
			Guizhou	22	2.91
			Tibet	3	0.40
			Chongqing	30	3.96
South China	34	4.49	Guangdong	17	2.25
			Guangxi	12	1.59
			Hainan	5	0.66
Central China	118	15.59	Hubei	19	2.51
			Hunan	23	3.04

			Henan	47	6.21
			Jiangxi	29	3.83
North China	82	10.83	Beijing	4	0.53
			Tianjin	2	0.26
			Hebei	39	5.15
			Shanxi	23	3.04
			Inner Mongolia	14	1.85
North-east China	40	5.28	Liaoning	15	1.98
			Jilin	10	1.32
			Heilongjiang	15	1.98

Data source: Chinese Thousand Village Survey in 2018.

We descriptively analyze the data and make the following summaries:

(1) Village ecological environment is being improved.

Among the surveyed villages, 88.6% have significantly improved their living environment in the past five years. The air quality of 24.7% of the villages and the water quality of 37.8% have improved significantly in recent years. 65.7% of the villages have popularized greening in public places. 57.6% of villages have popularized yard greening, 61.2% of villages have popularized greening before and behind houses, and 72% of villages have good road greening. 60.1% of the villages have good river greening conditions.

(2) Prominent environmental problems exist in some villagers.

In 148 villages, 20% of total, environmental quality is still the primary threat to the health of local villagers. As seen in Figure 1, about 42% of the villages have a certain degree of environmental pollution, and about 1% of the villages are in a state of serious pollution.

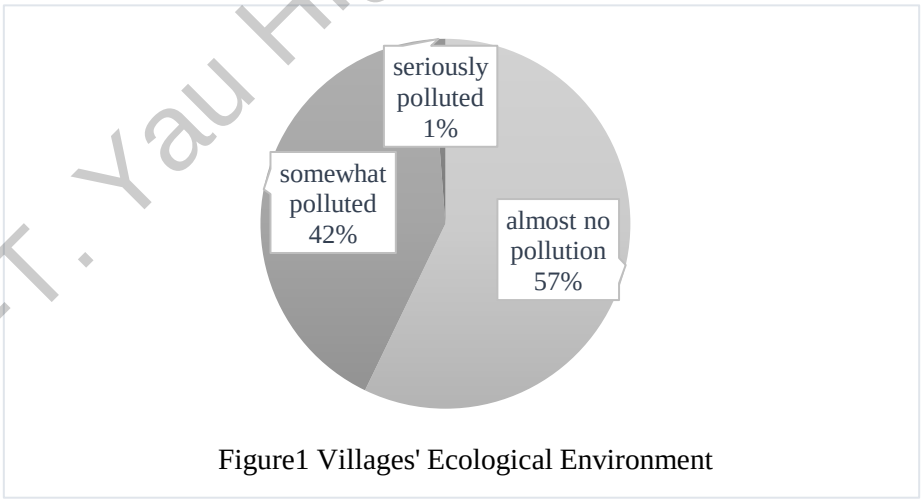

Figure1 Villages' Ecological Environment

(3) Domestic pollution: the main source of pollution in villages

Pollutions can be categorized into enterprise pollution, traffic pollution, agricultural pollution, and domestic pollution. In urban areas, the main sources are traffic and enterprise pollutions, but according to Figure 2, domestic pollution is the most important one in villages, accounting for 53%. The possible reasons for the severity of domestic pollution are the mass production of the consumption economy,

dated garbage disposal systems, and people's low awareness of garbage disposal. Due to the consumption economy, people use many cheap one-time products made of plastic, which cannot be disposed in the traditional rural garbage disposal systems. As people carelessly throw these harmful products in the wild, the ecological environment and even the water body is polluted (Fisher, 2020). 26% of the villages are caused by the waste generated in the production process of the enterprise, probably due to the ineffective supervision on rural factories. 21% of the villages are caused by the agricultural pollution, such as overuse of chemical fertilizers and pesticides in agricultural production. The effect of traffic pollution is minimal, as there are not many cars in the rural area.

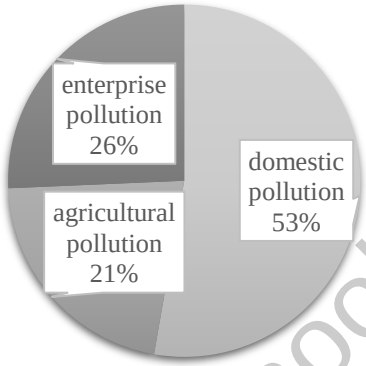

Figure2 sources of rural pollution

(4) The environment-friendly idea in the village is weak

On one hand, the concept of environment-friendly is not fully publicized at the village level. According to the village questionnaire, 15.5% of the villages have not carried out any form of publicity on the concept of "green water and green mountains are golden mountains and silver mountains", and some villages that have carried out publicity generally have problems such as a single form of publicity and insufficient publicity.

On the other hand, some villagers do not fully accept the idea. 21.7% of the villagers have never heard the saying that "green water and green mountains are golden mountains and silver mountains", and some of those who have heard of it do not understand the connotation of the concept. A small number of villagers believe that environmental protection is less important than economic development.

4 Data processing

4.1 The Dependent variable

The dependent variable in this paper is the ecological environment of the village. Combining the questionnaire data from the Thousand Villages Survey, the village's ecological environment status is divided into four secondary indicators: greening status, pollution status, environmental remediation status, and environmental degradation

events for scoring. Table 2 to 5 below assigns values to the answers to the questions in the questionnaire corresponding to the four secondary indicators. All indicators are positive indicators, that is, the higher the score of each question, the better the ecological environment of the village in this respect. The score of a village on these four secondary indicators is the sum of the scores of several questions corresponding to this indicator. For example, the full score of a village on the greening status is the sum of the full scores of five indicators, which is 10.

Table 2 Index System of Greening status

1. What is the status of river greening?	Better= 2	Lesser= 1	None= 0
2. Road greening status?	Better=2	Lesser=1	None=0
3. How about the greening of the courtyard?	widespread=2	Lesser=1	None=0
4. Greening status before and after the house?	widespread =2	Lesser=1	None=0
5. The greening status of public places?	widespread =2	Lesser=1	None=0

Table 3 Index System of Pollution status

1. Is environmental quality the primary threat to the health of local residents?	Not = 1 Yes=0
2. What is the current air quality in the village?	The air has no peculiar smell all year round = 3 Occasionally a pungent smell (several times a month) = 2 Often can smell pungent smell (several times a week) = 1 I can smell a pungent smell almost every day = 0
3. What is the current water quality of the rivers (or lakes, ponds) flowing through the village?	Can be consumed directly = 4 Swimming and washing clothes are no problem = 3 Can be used to flush toilets, etc. = 2 Basically unusable = 1 Black water stinks = 0

Table 4 Index System of Environmental remediation status

2. Has there been any significant change in the quality of water bodies in recent years (after 2015)?	Improvement=2 No change, maintenance=1 deterioration=0
3. Has the living environment of the village been significantly improved in the past five years?	Yes=1 No=0

Table 5 Index System of Environmental degradation event

1. In recent years (after 2015) has the production of crops in the village been reduced due to environmental pollution?	No=1 Yes=0
2. In recent years (after 2015) has the production of livestock and poultry in the village been reduced due to environmental pollution?	No=1 Yes=0
3. In recent years (after 2015) have the aquaculture activities in the village reduced aquatic production due to environmental pollution?	No=1 Yes=0
4. In the past five years, have there been environmental mass incidents in the	No=1

village?	Yes=0

After getting the scores of the four secondary indicators for each village, to facilitate the next data processing, the indicators are normalized so that their values fall between [0,1].

$$X^{'} = \frac{x-min}{max-min}$$

The next step is to determine the importance of these four indicators in affecting the ecological environment of the village, that is, what proportions they account for in the final score. The entropy method used in the processing is an objective weighting method.

$$p_{ij} = \frac{x_{ij}}{\sum_{j=1}^{n} x_{ij}}. \quad (1)$$

$$E_i = -\frac{\sum_{j=1}^{n} p_{ij} \cdot \ln p_{ij}}{\ln n}. \quad (2)$$

$$w_i = \frac{1 - E_i}{\sum_{i=1}^{m} (1 - E_i)}. \quad (3)$$

m: number of indicators
n: number of samples
x_{ij}: the ith indicator in the jth sample.
E: entropy
w: weight
This method is also used in Yuxin Zhu et al. (2020).

The basic idea of the method is to determine the objective weight according to the variability of the index. The smaller the information entropy of an indicator, the greater the degree of variation of the indicator value, the more information provided, the greater the role it can play in the comprehensive evaluation, and the greater its weight. (Wang Xiaojun et al. 2017)

Table 6 below shows the specific indicator weights of the village ecological environment calculated by the entropy method. It can be seen from Table 6 that among the four secondary indicators, the village's greening status is the most important with the highest weight (42.1%). The product of the normalized value of each secondary index of a village and the index weight is the score of the ecological environment of the village.

Table 6 The weight of each indicator of the village's ecological environment

greening status	pollution status	Environmental remediation status	Environmental degradation event
0.421	0.241	0.200	0.138

4.2 Core independent variables

"Green water and green mountains are golden mountains and silver mountains" is the main theory promoted by Chinese central government on the construction of China's ecological civilization. It means that, especially in rural areas, a good ecological environment can bring economic development, such as promoting tourism, agriculture, etc.; however, money cannot be exchanged for "green water and green mountains". This famous sentence promotes the importance of environmental protection. Therefore, we believe that whether the village committee promotes this concept can reflect environmental awareness of village committees, and the recognition of the concept by the villagers can also reflect the villagers' environmental awareness. The two core independent variables are defined as follows:

1. The environmental awareness of village committees (committee)

Table 7 Index System of Village Committees' Environmental Awareness

Questionnaire question	Assignment of value
Is there any form of publicity on the concept of "green water and green mountains are golden mountains and silver mountains" in the village?	Has = 1 No= 0

2. The environmental awareness of villagers (villager)

Table 8 Index System of Villagers' Environmental Awareness

Questionnaire question	Assignment of value
Do you agree with the saying that "green water and green mountains are golden mountains and silver mountains"?	"I strongly agree that green water and green mountains are fundamental" = 3 "Basically agree, not only green water and green mountains but also gold and silver mountains" = 2 "I don't agree, gold and silver mountains is more important" = 1 " Don't agree, don't want green water and green mountains, but also gold and silver mountains" = 0

Villagers' environmental awareness in a village is the average of the scores of all the villagers in the village.

4.3 Control variables

The control variables in this paper are mainly other characteristic variables at the village level. They are taken into consideration in the regression model to control the heterogeneity between different villages and ensure that the research results are more accurate. The control variables at the village level mainly include:

Table 9 Control variables used in the analysis

	Name	Questionnaire question	Assignment
1	Villagers' annual income per capita	Per capita annual net income of farmers in the village	Unit (ten thousand yuan)

2	Mobility	In the past five years, has there been a large-scale inflow or outflow of labor in this village?	Has = 1	No= 0
3	Public cultural facilities	Is there a library in the village?	Has = 1	No= 0
4	Public sports facilities	Are there places and equipment for public sports and fitness in the village?	Has = 1	No= 0
5	Enterprise status	Are there resource-dependent enterprises in the local area?	Has = 1	No= 0
6	traffic condition	How far is it from the nearest road to the village?	Unit (km)	
7	Promotional facilities	Is there a radio station in the village?	Has = 1	No= 0
8	Village rules	Does the village have village regulations and folk agreements?	Has = 1	No= 0
9	Village resident population		Logarithmic transformation	
1 0	Village arable land area		Logarithmic transformation	
1 1	Villager education status	The proportion of villagers with junior high school education and above		

Table 10 description of all variables

variable	Name	sample	Mean	Standard deviation	Minimum	Max
Y	Village ecological environment	757	.764	.14	.199	.966
committee	the environmental awareness of village committees	707	.83	.372	0	1
villager	the environmental awareness of villagers	752	3.672	.331	2.33	4
income	Villagers' annual income per capita	708	1.71	1.957	.05	20
mobility	Migration	757	.225	.418	0	1
Library	Public cultural facilities	756	.82	.385	0	1
Sports	Public sports facilities	757	.792	.406	0	1
enterprise	Enterprise status	757	.09	.288	0	1
highway	traffic condition	688	18.281	2 11.44	0	5213
broadcast	Promotional facilities	757	.589	.492	0	1
stipulation	Village rules	757	.905	.294	0	1
population	Village resident population	750	7.57	.904	3.97	10.309
plowland	cultivated area	7 00	7.51	1.331	1.327	14.867
education	Villager education status	6 47	.62	.243	0	1

4.4 Data missing processing

The data herein is from 757 villages in rural areas from across the country, but because of data collection and the different actual situation of the village for the absence of certain variables, we thus remove the samples with missing values in the village data, as a result, we have a sample with 545 villages. In the case of completely random missing values, the method of dealing with missing values in this way will not affect the model estimates in this paper.

5 Regression analysis

In order to explore the possible ways of village ecological environment governance under the concept of environment-friendly, this paper constructs the following basic regression analysis models from the perspectives of the environmental awareness of village committees and villagers:

$$y_i=\alpha_0+\alpha_1 c_i+\alpha_2 C_i+\varepsilon^1_i \quad (4)$$

$$y_i=\beta_0+\beta_1 v_i+\beta_2 C_i+\varepsilon^2_i \quad (5)$$

for sample i:
c: the environmental awareness of village committees
v: environmental awareness of the villagers
y: ecoindex, the ecological environment of the village
C: the control variable
ε: the residual item.

5.1 Correlation analysis

Before the regression analysis, this paper conducted a correlation analysis test on all variables. As seen from the result listed in Table 11, village's ecological environment (y) has a significant correlation with both the environmental awareness of village committees (c) and villagers' increased recognition of green development concepts (v). These two correlations can be further validated by regression analysis in the next part of the paper.

Many control variables have a strong correlation. For instance, education and mobility have a significant positive correlation. This is because when the score of mobility is high, it means that a large scale of people move in or out the village, then children who live in the village are more likely to travel to nearby towns or cities and receive education.

Table 11 Correlation Analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) ecoindex	1.000						
(2) committee	**0.200*** **	1.000					
(3) villager	**0.136*** **	0.121***	1.000				
(4) income	0.158***	0.033	0.162***	1.000			

(5) mobility	0.011	0.048	-0.046	-0.028	1.000		
(6) library	0.161***	0.127***	0.108***	0.016	0.055	1.000	
(7) sports	0.356***	0.139***	0.127***	0.137***	0.034	0.148***	1.000
(8) enterprise	0.043	-0.001	0.030	0.073*	-0.026	0.052	0.036
(9) highway	-0.005	0.009	-0.010	-0.005	0.009	0.036	0.006
(10) broadcast	0.030	0.120***	-0.052	-0.086**	0.101***	0.052	0.038
(11) stipulation	0.154***	0.232***	0.057	-0.051	0.003	0.058***	0.122***
(12) population	0.025	0.102***	0.053	-0.002	0.050	0.166***	0.090**
(13) plowland	0.019	0.012	-0.011	-0.179***	0.031	0.145***	0.020
(14) education	-0.032	0.020	-0.008	-0.016	0.096***	-0.001	-0.049

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(8) enterprise	1.000						
(9) highway	-0.042	1.000					
(10) broadcast	0.093**	-0.018	1.000				
(11) stipulation	0.008	-0.021	0.069*	1.000			
(12) population	-0.010	-0.026	-0.118***	0.030	1.000		
(13) plowland	0.017	0.014	0.065*	0.014	0.163***	1.000	
(14) education	0.009	0.075**	0.023	-0.034	0.030	0.060	1.000

*** p<0.01, ** p<0.05, * p<0.1

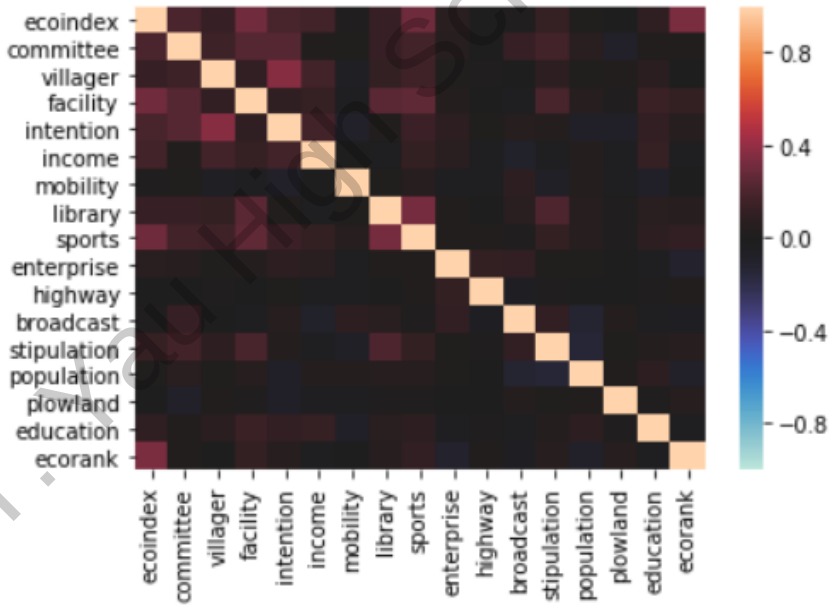

Figure 3 Heat diagram of the correlation of various variables

5.2 Multicollinearity test

Before performing regression analysis, consider the problem of multicollinearity between independent variables. Among them, the variance inflation factors (VIF) of villagers' environmental awareness (villager) and village laws (stipulation) are greater than 10, indicating the multicollinearity between these two variables. The existence of

multicollinearity will cause the regression parameters to become unstable and enlarges the variance of the parameters, so that the significance test of the variable will be meaningless.

Therefore, ridge regression is employed to solve the problem of multicollinearity. According to Yang Nan (2004), the method gives up unbiasedness least squares method and offers a more reliable and realistic regression coefficient at the expense of loss of part of the information and reduced precision. In our model, the ridge regression parameter penalty is taken as 0.05.

5.3 Regression results

Table 12 Basic regression analysis results

Variable	ecoindex (y)	
	Model (4)	Model (5)
committee (c)	**0.050*** **	
	(3.34)	
villager (v)		**0.032** **
		(2.03)
Income	**0.010*** **	**0.009*** **
	(3.03)	(3.07)
Mobility	0.002	0.004
	(0.192)	(0.30)
Library	0.007	0.000
	(0.434)	(0.2)
Sports	**0.082*** **	**0.088*** **
	(5.68)	(6.40)
enterprise	0.021	0.009
	(1.218)	(0.51)
highway	-0.000	-0.001*
	(-0.545)	(-1.79)
broadcast	-0.004	-0.002
	(-0.348)	(-0.17)
stipulation	0.035*	**0.043** **
	(1.539)	(2.17)
population	-0.005*	-0.003
	(-0.82)	(-1.38)
plowland	0.002	0.004
	(0.430)	(1.00)
education	0 .033*	-0.001
	(1.467)	(-0.04)
Constant	**0.612*** **	**0.521*** **
	(11.62)	(7.02)
Observations	545	545

Adjusted R^2	0.123	0.125

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regression results show that, in a village, the environmental awareness of villagers and the village committee has a positive influence on its ecological environment.

5.4 Testing the Normality of Error

First, we carry out the normality test of the error. Taking model (1) as an example, we can draw the model's standardized residuals and the residuals of the predicted values. We found that more than 95 % of the points are randomly published in [-2, 2] between.

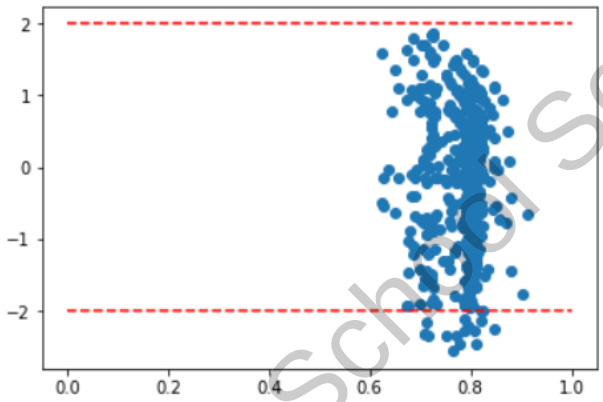

Figure 4 Standardized residual scatter plot

Then we found that the P value is greater than 0.05 through the test of homogeneity of variance (LR test), so the assumption of the same variance of error should be accepted.

Because the samples are not in time sequence, they do not have the problem of autocorrelation.

In conclusion, the regression model meets the Gauss-Markov condition, so our model has the lowest sampling variance within the class of linear unbiased estimators, which proves its accuracy.

5.5 Robustness Check

In order to further ensure the robustness of the basic regression results, we replaced the measurement indicators of the village's ecological environment with another question on the questionnaire and also assign values to the answers.

Table 13 Index System of Local Pollution levels

Questionnaire question	Assignment		
Local ecological environment	Almost no pollution = 3	Some pollution = 2	Severe pollution = 1

It can be seen from Table 13 that the higher the score, the better the ecological environment of the village. Since the dependent variable is discrete at this time, we use the Probit model for regression, referring to the research method of Wang Xueting et al. (2020). As seen from the result in Table 14, the regression results are basically consistent with those in the basic regression analysis, which proves the robustness of the conclusions.

Table 14 Regression Result of Robustness Check

Variable	ecoindex (y)	
	Model (4)	Model (5)
committee (c)	**0.070***	
	(1.85)	
villager (v)		**0.030***
		(1.70)
income	0.001	-0.004
	(0.03)	(-0.14)
mobility	0.035	0.017
	(0.29)	(0.14)
library	0.095	0.099
	(0.65)	(0.67)
sports	0.310**	0.323**
	(2.34)	(2.44)
enterprise	-0.539***	-0.536***
	(-3.28)	(-3.27)
highway	0.001	0.001
	(0.63)	(0.67)
broadcast	-0.174	-0.164
	(-1.62)	(-1.54)
stipulation	0.198	0.239
	(1.05)	(1.28)
population	-0.212***	-0.205***
	(-3.55)	(-3.44)
plowland	0.026	0.017
	(0.66)	(0.43)
education	0.283 *	0.296 *
	(1 .81)	(1 .85)
Pseudo R^2	0.323	0.377
Likelihood ratio test	34.83***	34.55***
Log likelihood	-443.167	-441.292
Observations	5 45	5 45

6 Analysis of heterogeneity

Village ecological environment pollution has different sources. In order to analyze the impact of village committees and villagers' willingness to protect the environment

on different types of pollution in more details, we divide the research samples according to pollution sources and conducted heterogeneity analysis.

Table 15 Results of heterogeneity analysis

	Model (4)			Model (5)		
pollution variable	Domestic pollution (1)	Agricultural pollution (2)	Enterprise pollution (3)	Domestic pollution (4)	Agricultural pollution (5)	Enterprise pollution (6)
committee	**0.046***	0.065	0.046			
	(1.76)	(1.624)	(1.192)			
villager				**0.063****	0.011	0.078
				(2.35)	(0.21)	(1.67)
Income	0.011**	0.001	0.008*	0.009*	0.001	0.007
	(2.02)	(0.04)	(1.29)	(1.656)	(0.05)	(1.17)
Mobility	-0.021	0.020	-0.011	-0.016	0.015	-0.011*
	(-0.961)	(0.568)	(-0.302)	(-0.73)	(0.426)	(-0.309)
Library	-0.008	0.011	0.084	-0.009	0.009	0.079
	(-0.322)	(0.205)	(1.828)	(-0.387)	(0.167)	(1.752)
sports	0.084***	0.039	0.072**	0.086***	0.045*	0.073**
	(3.60)	(0.92)	(1.875)	(3.747)	(1.031)	(1.906)
enterprise	0.035	0.071*	0.002	0.035*	0.074*	0.041*
	(1.051)	(1.328)	(0.726)	(1.064)	(1.364)	(1.108)
highway	0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-0.274)	(-0.347)	(-1.26)	(-0.261)	(-0.652)	(-1.136)
broadcast	-0.003	0.009	0.029*	-0.001	0.019	0.031
	(-0.131)	(0.272)	(0.919)	(-0.047)	(0.559)	(0.986)
stipulation	0.036*	0.014	0.013	0.041*	0.032	0.005
	(1.08)	(0.201)	(0.238)	(1.249)	(0.441)	(0.099)
population	0.008	0.013	0.003	0.007	0.014	0.006
	(0.76)	(0.65)	(0.182)	(0.716)	(0.664)	(0.326)
plowland	-0.000	0.012*	-0.013	0.001	0.013*	-0.013
	(-0.016)	(0.86)	(-1.254)	(0.221)	(0.932)	(-1.303)
education	0.058*	-0.046	0.1793***	0.057*	-0.047	0.190***
	(1.528)	(-0.663)	(2.918)	(1.518)	(-0.665)	(3.116)
Constant	0.527***	0.455***	0.459***	0.325**	0.429*	0.191*
	(6.003)	(2.834)	(2.774)	(2.619)	(1.73)	(0.871)
Observations	196	87	98	196	87	98
R^2	0.184	0.135	0.268	0.194	0.105	0.280

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

As seen from columns (1) and (4) of Table 15, only when the village's ecological and environmental problems are mainly caused by domestic pollution, the regression is significant. It means that raising the environmental awareness of village committees and villagers is helpful in improving the rural environmental circumstance. However,

according to the regression results in the remaining columns in Table 15 when the village's ecological environment problems are mainly caused by agricultural pollution and enterprise pollution, the regression results are not significant. The difference in the result is possibly resulted from the different causes of domestic pollution, agricultural pollution and enterprise pollution.

Specifically, domestic pollution is caused by the arbitrary disposal of domestic garbage and sewage and also the village's lack of domestic garbage and sewage treatment measures and equipment. The survey data shows that for the villages with domestic pollution, only a few villages carry out centralized sanitary landfill of garbage, and most villages cannot properly dispose of garbage because of incomplete facilities. However, agricultural pollution is mainly related to the overuse of chemical fertilizers and pesticides in the pursuit of crop yields and economic benefits, which have caused greater pollution to the village's soil and rivers. Besides, enterprise pollution is caused by industrial waste etc. The survey data shows that the most important source of enterprise pollution is private manufacturing companies. Driven by their personal interests, the business owners will ignore ecological and environmental issues. Meanwhile, compared with cities, rural areas lack strict supervision measures, especially for these private companies. Small enterprises, whose emissions are hidden and difficult to find, have brought great difficulties to the ecological environment governance.

Concluded from the above analysis, domestic pollution can be greatly reduced by strengthening the publicity of environmental awareness in rural areas. It will help to increase the village committee's enthusiasm in carrying out ecological environmental governance and dissuade villagers from directly throwing their garbage into the nature. Nevertheless, the entities that produce agricultural and enterprise pollution are driven by economic benefits, so it is difficult to simply rely on the constraints of consciousness to solve the problem. The enactment of relevant legislations and strict enforcement of the existing laws may be a better solution.

7 Analysis of mediation effect

7.1 The mediation effect of the village environmental infrastructure construction

After the positive influence of village committees' environmental awareness on environment is proved, it leaves a question that how the awareness can result in better environment in reality. Our hypothesis is that after the village committee pays more attention to the concept of green development, it will strengthen the construction of the village's environmental infrastructure, which improves environment.

According to Li Guanjie (2017), Tang Ning et al. (2018), Li Yurui, et al. (2020), and the survey data, the measurement of infrastructure is consisted of waste disposal facilities and living facilities.

Table 16 The Index System of Villages' environmental infrastructure

category	Questionnaire question	Assignment
Garbage treatment facility	Sewage treatment method	Household construction and treatment facilities = 3 The village has centralized processing facilities = 2 Discharged into the urban sewage pipe network = 1 No treatment facility = 0
	Domestic waste treatment method	Sanitary landfill in the village (with anti-seepage disinfection) = 4 Transfer to a small incinerator in a town or village for treatment = 3 Simple landfill in the village (no anti-seepage disinfection) = 2 Open-air storage after centralized collection = 1 No centralized collection, each household solves it by itself = 0
Life service facilities	Road hardening	Basically, all roads in the village are hardened = 2 Only the main roads in the village are hardened = 1 No hardening of main roads in the village = 0.
	Has the village implemented the family toilet improvement work?	Yes = 1 No = 0

We use the entropy method again to calculate the weights of the two types of infrastructure in the final score, the result showed in Table 17 below. Indicated by the percentage, Garbage treatment plays a larger role than life service. The score of a village's environmental infrastructure construction status, which is referred to as “facility” in the model below, is the combination of the weights in Table 17 and the scores of the two facilities in Table 16.

Table 17 The weight of each indicator of the village's environmental infrastructure status

Garbage treatment facility	Life service facilities
0.6498239	0.3501761

Next, we refer to the research of Wen Zhonglin and Ye Baojuan (2014) on mediating effect and set the following test model:

$$f_i = \gamma_0 + \gamma_1 c_i + \gamma_2 C_i + \varepsilon^3_i \quad (6)$$

$$y_i = \alpha_0 + \alpha_1 c_i + \alpha_2 f_i + \alpha_3 C_i + \varepsilon^4_i \quad (7)$$

For sample i:

f_i: the construction of environmental infrastructure in the village. The larger the value of this index, the better the construction of environmental infrastructure in the village.

c_i: the environmental awareness of village committees

y_i : ecoindex, the ecological environment of the village

C_i : the control variable

ε_i: the residual item

The results are shown in columns (1) and (2) in Table 19.

7.2 The mediating effect of villagers' willingness to protect the ecological environment

How villagers' attitudes about environmental protection specifically work in improving environment remains unknown. Our hypothesis is that after the villagers' recognition of the green development concept increases, their willingness to participate in the village's ecological environment governance will also increase accordingly, which is conducive to the village's ecological environment governance. The willingness of villagers to participate in environmental protection can be measured through the following two questions.

Table 18 Index System of villagers' willingness to protect the ecological environment

Questionnaire question	Value Assignment
Are you or other members of your family concerned about the monitoring of river water quality by government agencies?	Did not pay attention or did not know that there is relevant detection information assignment = 0 Occasional attention = 1 Always pay attention to assignment = 2
Are you or other members of your family concerned about the air quality monitoring status of government departments?	Did not pay attention or did not know that there is relevant detection information assignment = 0 Occasional attention = 1 Always pay attention to assignment = 2

Based on the answers to the above two questions, the average willingness of villagers to improve the ecological environment can be calculated at the village level.
Then, we set the following test model:

$$I_i = u_0 + u_1 v_i + u_2 C_i + \varepsilon^5{}_i \quad (8)$$

$$y_i = \beta_0 + \beta_1 v_i + \beta_2 I_i + \beta_2 C_i + \varepsilon^6{}_i \quad (9)$$

For sample i:
I: the willingness of villagers to participate in ecological environmental governance. The larger the value of this index, the stronger the willingness of villagers to participate in ecological environmental governance
v: the recognition of the green development concept of the villagers
y: ecoindex, the ecological environment of the village
C: the control variable
ε: the residual item

The specific regression results are shown in columns (3) and (4) in Table 19.

Table 19 Regression Results of Mediation Effect

variable	facility	ecoindex	intention	ecoindex
	(1)	(2)	(3)	(4)
committee	0.082***	0.037**		
	(4.134)	(2.506)		
facility		0.155***		

		(4.944)		
villager			0.201***	0.007
			(8.274)	(0.366)
intention				0.083***
				(2.796)
income	0.006	0.008***	0.009**	0.008***
	(1.468)	(2.776)	(1.966)	(2.677)
mobility	-0.007	0.003	-0.030	0.006
	(-0.386)	(0.277)	(-1.625)	(0.472)
Library	0.080***	-0.006	-0.020	0.009
	(3.850)	(-0.360)	(-0.872)	(0.560)
Sports	0.068***	0.072***	0.045**	0.082***
	(3.515)	(5.002)	(2.121)	(5.648)
Enterprise	0.017	0.019	0.040	0.021
	(0.706)	(1.095)	(1.530)	(1.154)
Highway	-0.000	-0.000	0.000	-0.000
	(-0.424)	(-0.467)	(0.354)	(-0.608)
Broadcast	-0.020	-0.001	0.027	-0.002
	(-1.272)	(-0.088)	(1.569)	(-0.156)
Stipulation	0.090***	0.021	-0.003	0.043*
	(3.022)	(0.929)	(-0.085)	(1.923)
Population	0.005	-0.006	-0.015*	-0.002
	(0.618)	(-0.966)	(-1.737)	(-0.345)
Plowland	-0.015***	0.004	-0.006	0.002
	(-3.093)	(1.079)	(-1.097)	(0.686)
Education	0.066**	0.023	0.058*	0.027
	(2.162)	(1.039)	(1.746)	(1.188)
Constant	0.357***	0.557***	0.189*	0.524***
	(5.100)	(10.539)	(1.696)	(6.844)
Observations	545	545	545	545
Adjusted R^2	0.163	0.159	0.161	0.119

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Column (1) in Table 19 first proves the positive effect of the committees' attitudes on the construction of environmental infrastructure. Because in column (2), the coefficient of both facilities and committees' attitudes are significant and nonzero, it can be concluded that the environmental infrastructure in villages has partial mediating effect in the model.

Column (3) in Table 19 also firstly proves the positive effect of the villagers' green development concept recognition on the villagers' willingness to take action. In column (4), the coefficient of villagers' willingness to take action is significantly nonzero, but the coefficient of villagers' acceptance of the green development concept is insignificant. This represents that villagers' willingness to protect the ecological environment plays a completely mediation role.

Thus, the validity of the two mediating effects further proves that raising the awareness of village committees and villagers are helpful in protecting the environment.

8 Conclusion and Suggestion

The improvement of village ecological environment governance is crucial to the rural revitalization and modernization. After analyzing the data from the Chinese Thousand Village Survey in 2018, we conclude that:

(1) The more attention that a village committee attach to environmental protection, the better the local environment will be; the village committee will transform their environmental consciousness into the construction of environmental infrastructure, which directly reduces the pollution. Also, the higher the villagers' recognition of green development concepts, the better the ecological environment; after the villagers accept the concepts, they will be willing to participate in the ecological environment governance, so as to help improve the ecological environment of the village.

(2) Due to the different main sources of village pollution, the governance methods on environment will change accordingly. The attention of the village committee and the conscious behavior of the villagers can help to deal with domestic pollution, but has limited impact on agricultural and enterprise pollution.

Based on the research conclusion, we propose the following two suggestions:

(1) Attach importance to the publicity of eco-friendly development. On one hand, government departments can organize regular training of village chiefs and introduce certain assessment measures on village committees to stimulate their enthusiasm for protecting the environment. On the other hand, it is also necessary to raise the villagers' awareness of ecological priority. Local government and environmental protection organizations can send volunteers to give lectures, hand out leaflets, and talk with locals from village to village.

(2) Choose appropriate ecological environment governance methods in accordance with local circumstances. There are certain differences in the sources of village ecological environment pollution. Strengthening publicity of green development can deal with domestic pollution. But if enterprises and agriculture are the main sources of pollution, probably more rigid regulation is a better choice.

Reference:

[1] Chen Yelan. On the Government's Reorientation in the Construction of Rural Ecological Civilization [J]. *Jiangxi Social Sciences*, 2013, 33(08):189-193.

[2] Du Xi. Population Quality in Rural Green Development and Ecological Civilization Construction——A Discussion Based on Dilemmas and Strategies[J]. *Theory Monthly*, 2018(02):154-160.

[3] Feng Yangxue, Xu Kun. Government Responsibilities in Governance of Rural Ecological Environment: Frame Analysis and System Response[J]. *Social Sciences in Guangxi*, 2017(05):125-129.

[4] Fisher, Charles. *Rural Non-Point Source Pollution in China: Its origins, Dangers, and Management Techniques*. 2020. Ohio State University, Master's thesis. OhioLINK Electronic Theses and Dissertations Center.

[5] Hou Jundong, Lu Jun, Yin Weifeng. Effects of Farmer Households' Production and Operation Behaviors on Rural Eco-environment[J]. *China Population, Resources and Environment*, 2012, 22(03):26-31.

[6] Huang Senwei, Tang Dan, Zheng Yifang. Research on Public Participation Mechanism of Rural Environmental Governance——Taking Fujian Province as an Observation Case[J]. *Chinese Public Administration*, 2017(03):55-60.

[7] Jessop, Bob. "Capitalism and Its Future: Remarks on Regulation, Government and Governance." *Review of International Political Economy*, vol. 4, no. 3, 1997, pp. 561–581.

[8] Jin Taijun, Xue Ting. Meticulous Governance of Rural Ecological Environment: Logic Dimension and Practical Approach[J]. *Theoretical Investigation*, 2020(04):158-164.

[9] Li Guanjie. Who Should be Responsible for the Construction of Rural Environmental Infrastructure[J]. *People's Tribune*, 2017(19):58-59.

[10] Li Yongmei. Analysis of Public Participation in the Governance of Rural Ecological Environment [J]. *Rural Economy*, 2015(12):94-99.

[11] Li Yurui, Zhang Xuanchang, Chen Yangfen, Liu Yansui. The Impact of Human Settlement Quality on Rural Development: a Quantitative Analysis Based on the Cross-Sectional Data of Sampled Village in Jiangsu Province[J]. *China Population, Resources and Environment*, 2020, 30(08):158-167.

[12] Liu Miaoling, Yang Bingcheng, Wen Xiaowei. Analysis of Influencing Factors of Pesticide Waste Disposal Behavior——Based on the Survey of Farmers in Guangdong Province[J]. *Rural Economy*, 2014(09):108-112.

[13] Liu Zhao, Yang Xuyi. Rural Ecological Environment Crisis and Its Governance——Based on the Perspective of Public Goods Theory[J]. *Rural Economy*, 2011(03):104-108.

[14] Lou Shuwang. Environmental Governance: the Responsibility of the Local Government and Restrictive Factors[J]. *Chinese Public Administration*, 2016(03):48-53.

[15] Peng Xiaoxia. A Probe into the Mechanism of Community Participation in the Governance of Rural Ecological Environment in China[J]. *Theory Monthly*, 2016(11):170-176.

[16] Qu Yanchun. Government's Responsibility in Rural Environmental Governance: from the Perspective of Meta-governance[J]. *China Population, Resources and Environment*, 2021, 31(02):71-79.

[17] Shi Shengxu, Gan Caiyun. Environmental Protection Job Satisfaction, Environmental

Knowledge and Public Environmental Behavior——An Analysis of the 2013 Chinese General Social Survey[J]. *Soft Science,* 2017, 31(11):88-92.

[18] Su Fang, Fang Lei. “Active Government” and the Development of Rural Inclusive Finance: Based on “Thousands Villages Investigation” of SUFE 2015[J]. *Journal of Finance and Economics*, 2016, 42(12):72-83.

[19] Su Fang, Zou Yige, Han Dongmei. Best Path for Governments to Improve Internet Financial Inclusion in China’s Rural Areas: Based on the “Thousand Village Investigation” of SUFE in 2017[J]. *Journal of Finance and Economics*, 2020, 46(01):4-18.

[20] Tang Ning, Wang Cheng, Du Xiangzuo. Evaluation of Rural Human Settlements Quality and Its Differentiated Optimization in Chongqing Municipality[J]. *Economic Geography*, 2018, 38(01):160-165+173.

[21] Tang Renwu, Li Cheng. Strategy Choice of China's Environmental Governance from the Perspective of Meta-governance[J]. *China Population, Resources and Environment*, 2014, 24(02):18-22.

[22] Wang Qunyong, Zhao Wei, Liu Xuyang. Member Identity and Environment Protection: An Investigation Based on Identity Economics[J]. *China Economic Studies*, 2020(05):43-54.

[23] Wang Xiaojun, Wu Jingxue, Jiang Heping. Dynamic Assessment and Trend Prediction of Rural Eco-environmental Quality in China[J]. *Journal of Natural Resources*, 2017, 32(05):864-876.

[24] Wang Xueting, Zhang Junbiao, Tong Qingmeng. Does place attachment help to enhance farmers' willingness to participate in rural environmental governance?——based on the survey data of Hubei Province [J]. *China Population, Resources and Environment*, 2020, 30(04):136-148.

[25] Wen Zhonglin, Ye Baojuan. Analyses of Mediating Effects: The Development of Methods and Models[J]. *Advances in Psychological Science*, 2014, 22(05):731-745.

[26] Xiao Yongtian. Analysis of the Mechanism and Countermeasure of Social Capital Affect Rural Ecological Environment Governance[J]. *Theoretical Investigation*, 2018(01):113-119.

[27] Yan Xifeng. Ecological Responsibilities of Local Governments under the Concept of Green Development[J]. *Administrative Tribune*, 2020, 27(05):140-145.

[28] Yang Chan, He Xiaogang. Authority of Village Chiefs and the Rural Development: Empirical Analysis Based on CTVS Data[J]. *Management World*, 2019, 35(04):90-108+195-196.

[29] Yang Nan. Unique function of ridge regression in solving multicollinearity problems[J]. *Statistics and Decision*, 2004, 000(003):14-15.

[30] Yu Fawen. Rural Ecological Environment Governance in the "14th Five-Year Plan" Period: Dilemmas and Countermeasures[J]. *Studies on Socialism with Chinese Characteristics*, 2021(01):44-51+2.

[31] Yu Fawen. Research on the Countermeasures of Rural Ecological Civilization Construction from the Perspective of Green Development Concept[J]. *Studies on Socialism with Chinese Characteristics*, 2018(01):76-82.

[32] Yuxin Zhu, Dazuo Tian, Feng Yan, "Effectiveness of Entropy Weight Method in Decision-Making", *Mathematical Problems in Engineering*, vol. 2020, Article ID 3564835, 5 pages, 2020. https://doi.org/10.1155/2020/3564835

[33] Zeng Rui. Relationship between Rural Environmental Protection and Farmers' Participation [J]. *Chongqing Social Sciences*, 2017(02):61-69.

[34] Zhan Guobin, Chen Jianpeng. Towards Multiple Co-governance Model of Environmental

Governance——Realistic Challenge and Path Choice[J]. *CASS Journal of Political Science*, 2020(02):65-75+127.

[35] Zhang Sui, Zhang Mei, Chi Guotai. The Science and Technology Evaluation Model Based on Entropy Weight and Empirical Research During the 10th Five-Year of China[J]. *Chinese Journal of Management*, 2010, 7(01):34-42.

[36] Zhang Zhisheng. Study on the multi-governance model of rural ecological environment governance from the perspective of rural revitalization strategy[J]. *Journal of Chongqing University(Social Science Edition)*, 2020, 26(01):201-210.

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Related Code

#Import packages

```
import numpy as np
import statsmodels.api as sm
import statsmodels.formula.api as smf
from statsmodels.stats.diagnostic import het_white
from statsmodels.stats.outliers_influence import variance_inflation_factor
from scipy.stats import pearsonr
import pandas as pd
import matplotlib.pyplot as plt
import scipy.stats as stats
import seaborn as sns
```

#Data preprocessing

```
data=pd.read_excel(r'C:\Users\11782\Desktop\data_qcdc.xlsx')
data=data.dropna(axis=0, thresh=None,
subset=['committee','villager','intention','income','library','highway','population','plowland','education'], inplace=False)
data=data.reset_index(drop = True)
data.describe()
```

#Correlation coefficient

```
data_=data.iloc[:,4:]
data_.corr()
sns.heatmap(data_.corr(), vmax=1, vmin=-1, center=0)
cor_p=np.zeros((16,16))
for i in range(16):
    for j in range(16):
        cor_p[i,j]=stats.pearsonr(data_.iloc[:,i],data_.iloc[:,j])[1]
np.where(cor_p<0.01)
```

 # Multicollinearity test

```
data1= data_.drop(['ecoindex','facility','intention','ecorank','pollution'], 1)

VIF_list = [variance_inflation_factor(data1.to_numpy(), i) for i in range(data1.shape[1])]

print(VIF_list)
```

#Linear regression and Ridge regression

```
results_c = smf.ols('ecoindex ~ committee + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data_).fit()

print(results_c.summary())

results_v = smf.ols('ecoindex ~ villager + income + mobility + library + sports + stipulation + enterprise + highway + broadcast + np.log(population) + np.log(plowland) + education', data=data_).fit()

print(results_v.summary())

results_v_L1 = smf.ols('ecoindex ~ villager + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data_).fit_regularized(alpha=2, L1_wt=0.01)

results_v_L1. params
```

#Residual analysis

```
plt.scatter(results_c.fittedvalues,results_c.resid_pearson)

plt.hlines(2,0,1,color="red",linestyle='--')

plt.hlines(-2,0,1,color="red",linestyle='--')

plt.show()

het_white(results_c.resid,results_c.model.exog)
```

#Analysis of heterogeneity

```
data_1=pd.read_excel(r'C:\Users\11782\Desktop\data_qcdc.xlsx')

data_1=data_1.dropna(axis=0, thresh=None, subset=['committee','villager','intention','income','library','highway','population','plowland','education','pollution'], inplace=False)

data_1=data_1.reset_index(drop = True)

data_life=data_1[data_1['pollution']=='生活污染']
```

```
data_arg=data_1[data_1['pollution']=='农业污染']

data_firm=data_1[data_1['pollution']=='企业污染']


results_l1 = smf.ols('ecoindex ~ committee + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data_life).fit()

print(results_l1.summary())

results_a1 = smf.ols('ecoindex ~ committee + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data_arg).fit()

print(results_a1.summary())

results_f1 = smf.ols('ecoindex ~ committee + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data_firm).fit()

print(results_f1.summary())

results_l2 = smf.ols('ecoindex ~ villager + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data_life).fit()

print(results_l2.summary())

results_a2 = smf.ols('ecoindex ~ villager + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data_arg).fit()

print(results_a2.summary())

results_f2 = smf.ols('ecoindex ~ villager + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data_firm).fit()

print(results_f2.summary())
```

#Analysis of mediation effect

```
results1 = smf.ols('facility ~ committee + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data).fit()

print(results1.summary())

results2 = smf.ols('ecoindex ~ committee + facility + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data).fit()
```

```
print(results2.summary())

results3 = smf.ols('intention ~ villager + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data).fit()

print(results3.summary())

results4 = smf.ols('ecoindex ~ villager + intention + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + np.log(population) + np.log(plowland) + education', data=data).fit()

print(results4.summary())
```

#Robustness Check

```
library('MASS')

setwd("C:/Users/11782/Desktop")

data_=read.csv("data_qcdc.csv",encoding = "UTF-8")

results<-polr(factor(ecorank) ~ committee + income + mobility + library + sports + enterprise + highway + broadcast + stipulation + log(population) + log(plowland) + education ,weights = freq, data = data_,method = 'probit')
```