sustainability

MDPI

Article

Changes in Environmental Awareness and Its Connection to Local Environmental Management in Water Conservation Zones: The Case of Beijing, China

Yi Du [1], Xiaoyan Wang [1,*], Daniele Brombal [2], Angela Moriggi [2,3], Andrew Sharpley [4] and Shujiang Pang [1]

1 College of Resources, Environment & Tourism, Capital Normal University, Beijing 100048, China; duyi8568536@163.com (Y.D.); 2150901002@cnu.edu.cn (S.P.)
2 Department of Asian and North African Studies, University Ca' Foscari Venice, Dorsoduro 3462, 30123 Venezia, Italy; daniele.brombal@unive.it (D.B.); angela.moriggi@unive.it (A.M.)
3 Luke Natural Resources Institute Finland (LUKE), Latokartanonkaari 9, 00790 Helsinki, Finland
4 Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR 72701, USA; sharpley@uark.edu
* Correspondence: wangxy@cnu.edu.cn

Received: 4 June 2018; Accepted: 15 June 2018; Published: 19 June 2018

Abstract: This paper aims at investigating the change over time in the environmental awareness in rural Chinese communities and its correlation with environmental management measures implemented at the local level. We identify three main components of awareness, namely: perception, behavior, and attitude toward environmental management measures. Data were collected from two surveys in three villages in northern China in 2006 and 2015 that interviewed 125 and 129 respondents, respectively, and were analyzed employing an Analytic Hierarchy Process (AHP) approach. The results discussed in the paper show that environmental awareness increased between 2006–2015, and was mainly manifested in better environmental behavior and understanding of environmental status due an improvement in rural infrastructure and a greater amount of information provided to rural residents about the environment. Place of residence had a considerable influence on respondents' environmental awareness: residents in eco-villages had a higher environmental awareness than those living in common agricultural villages. This appears to indicate a positive nexus between the comprehensiveness of environmental management measures implemented locally, and environmental awareness. Also, the universality of environment issues reduced the importance of socioeconomic and demographic factors in determining the degree of environmental awareness. However, more attention should be paid to villagers' external behavior and inner feelings, such as their attitude to governmental management policies. These findings yield important policy implications that are relevant to the promotion of environmental awareness in China's rural communities, and the adoption of more effective environmental management measures.

Keywords: environmental awareness; environmental behavior; environmental perception; environmental attitude; environment management; Beijing

1. Introduction

In light of growing concerns over environmental problems, China has established policies and programs aimed at establishing a harmonious relationship between human activities and nature [1]. Environmental awareness is assumed to be an important prerequisite of environmental protection, and one the most important indicators of China's current striving toward more systemic progress that takes socio-environmental relations into account. Therefore, fostering environmental awareness is

of great importance to enhance the effectiveness and responsiveness of environmental management policies and strengthen public engagement. In order to improve environmental awareness, the first priority is to understand current public levels [2].

Historically, the development of environmental awareness among the Chinese public and decision-makers since the early 1970s has been greatly influenced by Western practices and the promotion of environmental discourses and best practices by the United Nations. A key event in the promotion of environmental awareness in China was the first National Conference on Environmental Protection, held in 1973, which laid the foundation for the first policies aimed at curbing pollution [3,4]. Since then, people have gradually realized the relationship between economic development and environmental degradation. In the 1990s, China's reforms achieved remarkable economic development by shifting from a centrally planned economy to a market-oriented one. However, reforms caused a number of serious social and environmental issues, including the degradation of water quality [5,6]. Meanwhile, the environmental crisis further spurred the increase in environmental awareness. The former State Environmental Protection Administration (SEPA, now the Ministry of Ecological Environment) increased environmental awareness in China. In 1992, SEPA and the State Education Commission jointly held the first National Environmental Education Work Conference, which was aimed at enhancing environment awareness [7].

In recent years, Chinese authorities have made considerable efforts to speed up the environmental protection process, pursue new policies and regulations, establish environmental information disclosure systems, and institutionalize public participation in environmental decision-making. However, environmental governance involves multiple stakeholders who must work together to manage risk and safeguard their own interests. Since the 1970s, environmental protection has become one of the core tasks of the government. The central government of China, along with local government, the agency of the policy implementation, began to give more priority to environmental concerns for policy-making [1,8]. These efforts have been targeted at improving administrative enforcement, environmental transparency, and environmental awareness [3,9,10]. Nevertheless, according to the Chinese livelihood index for environmental protection, China's public environmental awareness is still low, relevant public engagement is not high, and environmental satisfaction levels are inadequate [11,12]. The 18th People's Congress in 2012 clearly emphasized the promotion of ecological civilization to a strategic level and the popularization ecological civilization, so that all people can form a shared consciousness of environmental protection and practice care for the ecological environment [13].

In-depth and comprehensive surveys and research on public environmental awareness in China have been conducted in recent years. Several studies in three main river watersheds (the Huaihe, Haihe and Liaohe rivers), three main lake watersheds (Tai, Chao, and Dianchi lakes), and Songhua River Basin of China focus on the knowledge of environmental conditions and stakeholders' participation in environmental protection [14–17]. These studies involve many stakeholders, such as all citizens (Chinese Public Environmental Protection and People's Livelihood index, 2008), citizens in big cities [18], college students [19], tourists, and residents of the tourism community [20,21]. Results show that due to low environmental awareness, people often show little enthusiasm for environmental participation [22].

However, these studies are mostly concerned with measuring the level of understanding of environmentally-related concepts at a certain point in time. As such, they lack a diachronic, dynamic perspective. Also, they do not reflect the connection with environmental management. In this respect, little attention has been given to the link between changes in environmental awareness and implemented environmental management policies [22,23]. In the context of ecological civilization construction [13] and rural-to-urban labor migration [24], little effort has been made to understand change over time of awareness, which could reflect the effects of public dissemination and education, and their capacities to stimulate a public sense of responsibility [18]. Understanding the change in environmental awareness would be particularly important in areas that are undergoing rapid

development and social change, such as rural areas in China. Thus, understanding relationships among environmental behavior, perception, attitude, and overall environmental awareness is increasingly important to policy-makers and social scientists [25].

Environmental awareness can be defined as the ability of an individual to understand the connection existing between: (a) human activities, (b) the current status of environmental quality [26,27], and (c) his/her willingness to take part in environment activities [28]. Based on such an understanding, some studies have divided environmental awareness into three components: environmental knowledge, attitude, and concern [29]. It may be affected by a number of variables, including cognitive attitudes, life experiences, demographics, behavioral motivations, and intentions [30]. For the purpose of our paper, we define environmental awareness as consisting of three components: environmental behavior, perception, and attitude.

Environmental behavior is defined as the complex of activities informed by a concern for future generations, other species, or the whole ecosystem [31,32]. Environmental perception refers to the knowledge of, or feelings about, the environment, and the act of understanding the environment through our senses [33]. It is the understanding of the environment resulting from visual, auditory, and tactile experience, and also by information disclosure. It can reflect the respondents' degree of satisfaction with the water quality [34]. Finally, environmental attitude refers to the emotional response of people to environmental problems, which may trigger positive action for the environment. It is assumed to relate to the core principle of environmental awareness [35], and be affected by local institutions [36]. Therefore, it is necessary to strengthen grassroots management by making the village committee more effective for the villagers. On the other hand, providing well-reasoned, data-based, and logical messages, such as environmental management policies and plans, environmental impacts, the costs of environmental protection, and benefits from environmental protection should be effective in improving the credibility of the government. Thereby, the willingness of respondents to adopt certain management measures will increase [37,38].

Based on these three aspects, this paper addresses shortcomings in the literature mentioned above by focusing on changes in environmental awareness among rural communities and their relation to environmental management measures. In terms of behavior, we focus on methods of household garbage and feces disposal, which could cause non-point pollution by rainfall runoff, if not properly handled. With regard to perception, we analyze the perceived environmental quality of water among targeted communities. Finally, with reference to attitude, we focus on the response of communities to governmental environmental management measures and their willingness to contribute to their implementation. Besides providing evidence of changes in awareness over time, our study also seeks individual correlations between local environmental management institutions and environmental awareness. Finally, we analyze how the perception of worsening environmental pollution may alter public behavior.

2. Study Area

The Miyun Reservoir basin is located north of Beijing, and the Miyun reservoir is the main source of drinking water for Beijing (Figure 1). Mountains account for 80% of this drainage area, and there is 72.5% forest coverage. Since 2005, adhering to the principle of "high standard, low cost, affordable, and popularizing" set by the Miyun government, Miyun county has implemented various policies and measures, such as returning farmland back to forests, using conservation tillage, encouraging garbage disposal, and strengthening sewage treatment in the county. This has contributed to improving the rural environment, reducing non-point source pollution, and protecting the Miyun Reservoir.

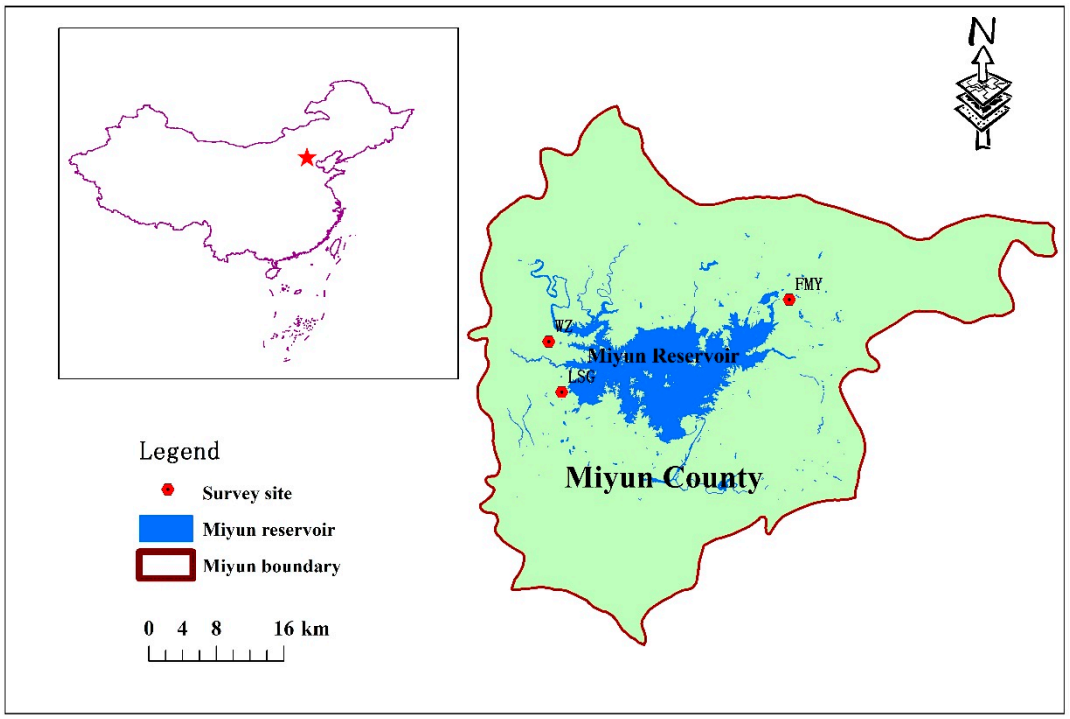

Figure 1. Location of the survey sites.

Three villages—Fangmayu (FMY), Lishugou (LSG), and Wangzhuang (WZ)—located in the conservation zone were selected as representative of the local environmental and socioeconomic conditions. According to Water Pollution Prevention and Control Law of the People's Republic of China (2008 Revision), building, rebuilding, or expanding construction projects discharging of pollutants into drinking water sources are banned in this conservation zone. The type and demographic information of the sample villages are listed in Table 1. LSG and WZ are eco-villages (shengtai cun) whose declared goal is to become more socially, culturally, economically, and ecologically sustainable [39]. In order to prevent Miyun Reservoir from receiving agricultural non-point source pollution, these two villages have partially transformed their development model from agricultural-based to one that is centered on ecological tourism. The main sources of income for residents of LSG and WZ are agriculture (corn, fruit), forestry, and rural tourism. FMY is located in the southeast of the Miyun Reservoir watershed. It is an agri-village (nongye cun) and the biggest of the sample villages with nearly 2000 residents. Its leading industries are agriculture and breeding. In recent decades, the Miyun Reservoir has experienced serious eutrophication due to non-point source pollution. Studies have shown that the reservoir has been severely polluted by rural and agriculture activities [40].

Table 1. Basic characteristic of the three villages in 2015.

Village Name	Type of Village	Total Households	Total Population	Permanent Population
Lishugou	Eco-village	108	245	160
Wangzhuang	Eco-village	103	235	200
Fangmayu	Agri-village	756	2156	1800

3. Methodology

3.1. Questionnaire Design

Two surveys were conducted in these villages to evaluate environmental public perception in 2006 and 2015. Original research questionnaires were modified by means of expert judgement and subjected to reliability and validity tests. Survey content included the following sections:

(1) Demographic and socioeconomic information, including age, gender, education level, and economic source.
(2) Environmental behavior, including wastewater treatment, garbage collection, and human and animal feces treatment.
(3) Perception of water environmental quality, including water quality and pollution status.
(4) Attitude towards environmental improvement, including residents' willingness to pay (WTP) for environmental management services, attitude towards environmental protection measures, and responsibility for environmental improvement [14].

3.2. Data Collection

The 2006 and 2015 surveys used a stratified sampling method. The population was classified into different strata based on sex, age, education level, and employment A simple random sampling was used in each category to extract sub-samples, and finally, these sub-samples together constitute the overall sample. Without increasing the size of the sample, this method can reduce sampling error and improve sampling accuracy.

Questionnaires were administered through face-to-face interviews. This allowed researchers to achieve a response rate of 98%, which is higher than what could be expected using other methods, such as mail and telephone surveys [41]. Prior to interviews, both the scope of the survey and individual questions were explained to respondents so that they could totally understand the rationale and contents of the survey. In 2015, the total number of questionnaires was 135, of which 129 were valid (95.6%). In 2006, 130 questionnaires were collected, of which 125 were valid (96.2%). All of the questionnaires were completed by adults ($\geq$18 years old).

3.3. Calculation Method

(1) Weight allocation

The Analytic Hierarchy Process (AHP) is a useful tool to handle complex decision-making problems and calculate variable weights according to relative importance. It has a wide variety of applications, such as strategic planning, resource allocation, business or public policy, and program selection [42]. The underlying logic of AHP is the establishment of a set of evaluation criteria and alternative options, which are used to make a best decision. The hierarchy structure model includes a target layer, a criterion layer, and an index layer (Figure 2). The rank is determined using pairwise comparison among criteria. For the purpose of this survey, this implied identification of the weight of each variable was used to calculate environmental awareness.

A survey in Shanghai pointed out that environmental protection behavior is the primary factor for improving environmental awareness, and the attitude toward environmental protection is an important restrictive factor [18]. A survey about smog pollution revealed that public awareness is mainly based on the perceptual knowledge in Shandong province [23]. In this study, the environmental awareness (target layer) consists of three aspects (criteria layers): environmental behavior, perception, and attitude. Several questions (index layer) address each aspect to evaluate these aspects (Figure 2).

To obtain the weight of each variable, pairwise comparison was done according to the scale guideline (Table 2) [43]. The pairwise comparison index for each criterion was summed, and outcomes were used for normalizing the pairwise comparison. The normalized index for each criterion was averaged to produce the weight vector. The weight vector was then verified through the consistency

ratio (*CR*) to ensure that judgments were consistent. If this verification failed, the pairwise comparison would have to be redone. Model tests show that environmental awareness, behavior, perception, and attitude had a consistency coefficient of less than 0.01, which was in accordance with the matrix test.

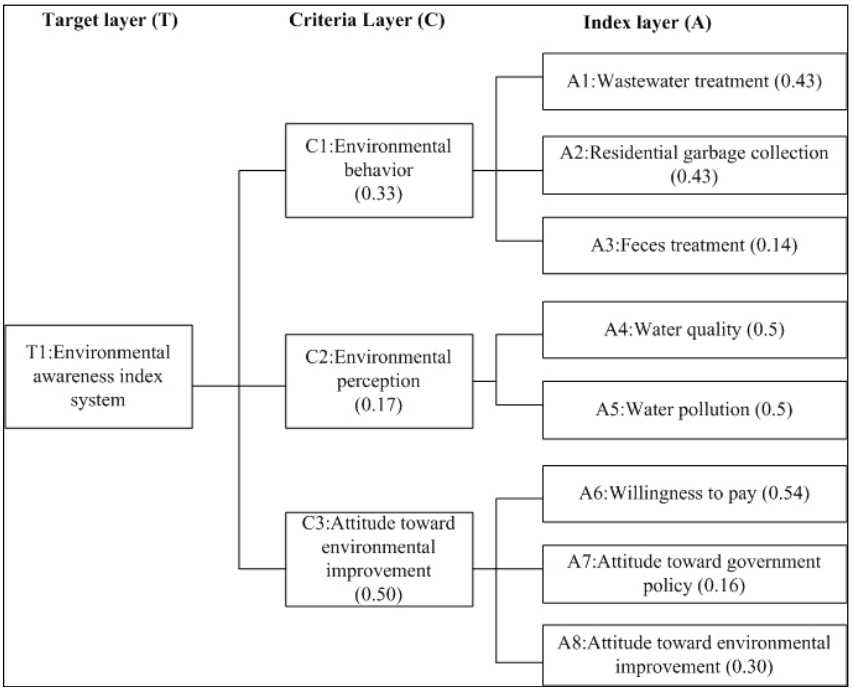

Figure 2. System used to determine the environmental awareness index, complete with weights of variables.

Table 2. The scale guideline for the Analytic Hierarchy Process (AHP) [44].

Intensity of Importance, on an Absolute Scale	Definition (Compare *i* and *j*)
1	Equal importance
3	Moderate importance of one over another
5	Essential or strong importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Intermediate values between the two adjacent judgments
Reciprocal	If activity *i* has one of the above numbers assigned to it when compared with activity *j*, then j has the reciprocal value when compared with *i*

The calculations are described by Equations (1) and (2). The comprehensive index (*CI*) depends on the maximum eigenvalue (λmax) and the number of factors in the judgment matrix (n). The consistency index (*RI*) is a predetermined value produced from a purely random matrix. The final verification was done by verifying whether the consistency ratio (*CR*), which was calculated using Equation (2), exceeded the acceptable value, which was set as 0.1 or less. According to relative importance, the importance matrix of each hierarchy is shown in the Tables 3–6, and the final weights are shown in Figure 2.

$$CI = (\lambda max - n)/(n - 1) \quad (1)$$

$$CR = CI/RI \quad (2)$$

Table 3. Environmental awareness matrix.

Environmental Awareness	Environmental Behavior	Environmental Perception	Environmental Attitude
Environmental behavior	1	2	0.6
Environmental perception	0.5	1	0.33
Environmental attitude	1.67	3	1

Note: Consistency ratio is 0.0012.

Table 4. Environmental behavior matrix.

Environmental Behavior	Wastewater Treatment	Feces Treatment	Residential Garbage Collection
Wastewater treatment	1	3	1
Feces treatment	0.33	1	0.33
Residential garbage collection	1	3	1

Note: Consistency ratio is less than 0.0001.

Table 5. Environmental perception matrix.

Environmental Perception	Water Quality	Water Pollution
Water quality	1	1
Water pollution	1	1

Note: Consistency ratio is less than 0.0001.

Table 6. Environmental attitude matrix.

Environmental Attitude	Willingness to Pay	Attitude toward Government Policy	Attitude toward Environmental Improvement
Willingness to pay	1	3	2
Attitude toward government policy	0.33	1	0.5
Attitude toward environmental improvement	0.5	2	1

Note: Consistency ratio is 0.0088.

(2) Calculation of comprehensive index

In the questionnaire, the environmental awareness included three criteria: environmental behavior, environmental perception, and attitude toward environmental improvement. Each criterion had several indicators (Figure 2). According to the different importance level of every indicator and every criterion, the points and weights were set differently. Considering the relative importance of every variable, an option in each question also had different level of value. Based on existing research [45,46], the comprehensive index was calculated as:

(a) Index layer:

$$A = \frac{10 \sum_{p=1}^{n} (Q_{jp} \times S_{jp})}{M}$$

where A is the index of each measureable variable, p is the alliterative option of question j, and n is the number of alliterative options. Q_{jp} represents the number of respondents who chose p, S_{jp} is the index of p, and M is the total number of respondents. Considering that people are used to a 100-mark system, the outcome was multiplied by 10.

(b) Criteria layer:

$$C = 10 \sum_{i=1}^{m} w_{ij} A$$

where C is the total index of every criterion, m is the question number; and w_{ij} is the weight of criterion i and indicator j.

(c) Index of target layer:

$$T = \sum_{i=1}^{3} w_i C$$

where T is the comprehensive index, and w_i is the weight of each criterion.

4. Results

4.1. Demographic and Socioeconomic Characteristics

Table 7 lists the demographic and socioeconomic characteristics of the study's sample. Respondents range in age from 18 to over 60 years old. In 2006, middle-aged people (35–60 years old) composed the majority (69.6%) of the sample. In 2015, the age of the main group of respondents was between 45–60 years old, which was the same percentage as people over 60 (39.5%), indicating an aging of the rural population. This is in line with other studies done in China, showing how the one-child policy has been a central factor in a rapid change in the Chinese age structure [47].

The migration of the young labor force to the city has been another factor resulting in an aging rural population. Education level ranges from illiterate to college or higher. The majority of respondents graduated from junior high school in 2006. However, there was an increase in education level in 2015. Those attaining a high school degree increased from 8.8% to 20.2%. Transformations of the economic structure produced significant changes of the main source of livelihood in surveyed communities. Traditional agriculture is no longer the main source of income; i.e., the percentage of households whose main income is from farming declined from 89.6% in 2006 to 13.2% in 2015. Now, the main sources of income are remittance from migrant workers (up from 1.6% to 51.2% of households) and rural tourism (from 0.0% to 19.4% in 2015). The improvement in social welfare, combined with the aging of the population, resulted in a higher percentage of people whose main source of income is from government subsidies (14.7% in 2015).

Table 7. Demographic and economic characteristics of the respondents.

Variable	Options	2006		2015	
		Number	Percent	Number	Percent
Gender	Male	71	56.8%	69	53.5%
	Female	54	43.2%	60	46.5%
	Total	125	100%	129	100%
Age	18–24	5	4%	6	4.7%
	25–34	17	13.6%	10	7.8%
	35–44	52	41.6%	11	8.5%
	45–60	35	28%	51	39.5%
	Over 60	16	12.8%	51	39.5%
	Total	125	100%	129	100%
Education level	Illiterate	15	12%	20	15.5%
	Primary school	31	24.8%	37	28.7%
	Junior high school	68	54.4%	42	32.6%
	High school	11	8.8%	26	20.2%
	College	0	0	4	3.1%
	Total	125	100%	129	100%
Economic source	Rural tourism	0	0	25	19.4%
	Farming	112	89.6%	19	13.2%
	Work outside	2	1.6%	64	51.2%
	Subsides	0	0	19	14.7%
	Other	11	8.8%	2	1.6%
	Total	125	100%	129	100%

4.2. Comprehensive Index of Environmental Awareness

Local respondents' environmental awareness was assessed from the combination of environmental behavior, environmental perception, and attitude toward environmental improvement according to the AHP model introduced in Section 3.3. The results are listed in Table 8.

The *T*-test showed that the overall environmental awareness ($p < 0.0001$), perception ($p < 0.0001$), and behavior ($p = 0.004$) had significant differences between 2006–2015. The total index increased from 47.77 to 52.97, which was mainly due to improvements in environmental behavior (9.41 to 11.23) and environmental perception (10.9 to 14.74). Along with the strengthening of rural infrastructure, the treatment of domestic sewage (17.92 to 36.98) and livestock manure (33.28 to 56.98) also improved. However, due to mismanagement, the level of domestic garbage treatment decreased, from 62.88 to 42.09. Environmental degradation greatly improved people's awareness of water quality and water pollution. No significant change in attitude toward environmental improvement was found ($p = 0.636$). However, a small decrease (27.46 in 2006 to 27.0 in 2015) was detected, showing a more negative predisposition toward environmental responsibility, government policy and measures, and residents' willingness to pay for environmental improvement.

Table 8. Descriptive statistics of environmental variables.

C	W	V	Options	W	Variable Index		Category Index		Weighted Index	
					2006	2015	2006	2015	2006	2015
EB	0.25	Wastewater treatment	0 Anywhere 3 Infiltration pool 5 Sewer without treatment 10 Sewer with treatment	0.43	17.92	36.98	37.65	44.90	9.41	11.23
		Domestic garbage treatment	0 Anywhere 8 Garbage can 10 Classified	0.43	62.88	42.09				
		Feces treatment	0 Roadside 3 Fertilizer 5 Garbage can 8 Pay someone to take away 10 Centralized disposal	0.14	33.28	56.98				
EP	0.31	Water quality	0 Do not care 3 General 6 Good 10 Poor	0.5	42.08	53.49	35.16	47.56	10.9	14.74
		Water pollution	0 Not clear 2 No pollution 5 Slightly polluted 10 Seriously polluted	0.5	28.32	41.63				
EA	0.44	Responsibility for environmental improvement	0 Not care 5 Government 10 People and society	0.3	78.70	77.91	62.4	61.31	27.46	27.0
		Attitude toward environmental protection measures	0 Against 3 Go with the flow 5 Comply with the direction made by local government 8 Support 10 Strongly Support	0.16	78.80	74.11				
		Willingness to pay	0 Against 3 Go with the flow 5 Comply with the direction made by local government 8 Support 10 Strongly Support	0.54	48.48	48.29				
TI									47.77	52.97

Category; W: Weight; V: Variable; EB: Environmental behavior; EP: Environmental perception EA: Environmental attitude; TI: Total index.

Residence has often been considered to exert substantial influence on a respondent's environmental awareness [23,48]. According to Figure 3, in 2006, the total index for the eco-villages (LSG and WZ) was significantly higher than for the agri-village (FMY) based on the T-test (sig. < 0.0001).

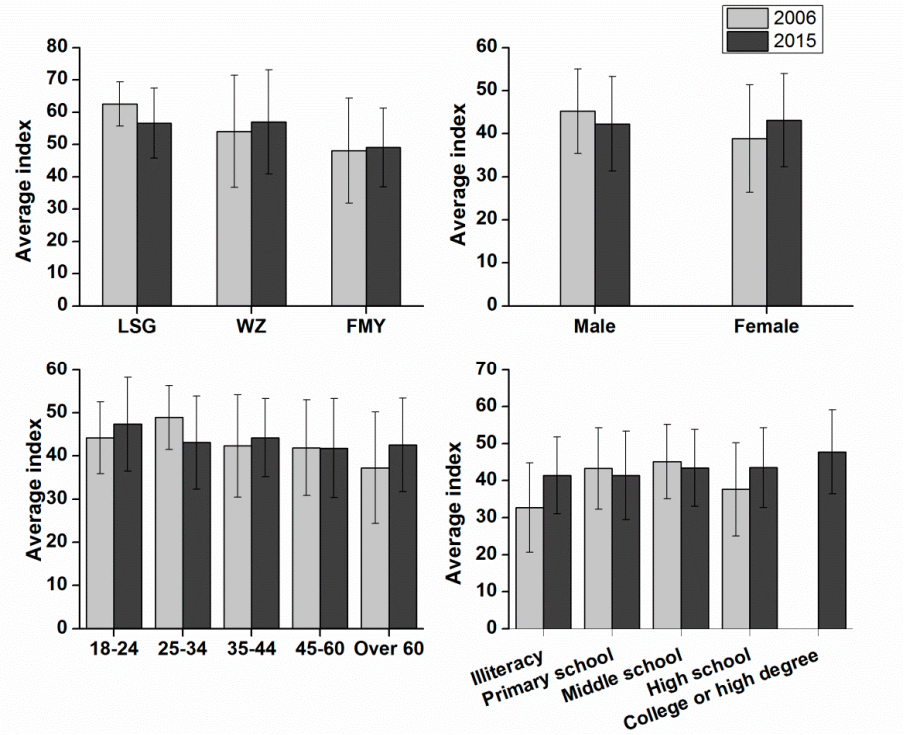

Figure 3. Comprehensive index of environmental awareness.

Over the last decade, LSG and WZ shifted from traditional agriculture to a tourism-based economy. Moreover, local authorities in these two villages devoted great attention to the development of wastewater collection and treatment infrastructure. Against this general background, the total index was supposed to increase, but there was actually a decline in the total index for LSG. The reason for this decline was that there was a large restaurant upstream of the village, which discharged wastewater without treatment. This appears to have impacted villagers' attitudes. Many thought that whoever causes pollution should be responsible for its treatment. In FMY, farming was still the main economic source. Although local policies have been implemented to return farmland to forest, many people still rely on planting chestnuts or corn. Since the rural development model has not changed, grassroots management caused the total index to remain the same.

In 2006, males had a better environmental awareness than females, while in 2015, the reverse was evident, suggesting that women's environmental awareness improved, which is consistent with previous research [49]. The cause of this reversal may lie in migration patterns. In the past, farming was mostly taken care of by men, who therefore developed a better understanding of their environment surroundings than females [14]. However, in recent years, most males choose to seek employment in big cities, while females stayed in the village and bore more responsibilities for the family, including ensuring food safety and family health [50]. Therefore, women are more concerned about environmental quality, report stronger environmental attitudes, and exhibit higher levels of behavioral adjustments compared with men [34,51].

Similar to other studies, young adults had higher environmental awareness [52]. This group has more opportunities to access environmental information through modern technology, and can better understand the causes and impact of water pollution [23].

Education level had a significant influence on environmental awareness in 2006, which is in line with published literature, showing a strong correlation with education [14,23,45]. The environmental awareness of illiterate people was the lowest. Respondents with primary and middle school education had a relatively high level of environmental awareness.

Compared with 2006, the environmental awareness of illiterate respondents and those with a high school education level in 2015 greatly increased. The increased importance and visibility of environmental problems resulted in people of different education levels having a relatively balanced environmental awareness in 2015.

4.3. Analysis of Changes in Environmental Behavior

Environmental behavior includes individual behavior in everyday life, and is measured by the participation behavior in the field of environmental protection and oversight. Among these, the daily behavior of residents is commonly deemed to be the most important feature [53]. From 2005, due to an improvement in wastewater treatment and manure disposal, environmental behavior increased from 37.65 to 44.9 between 2006–2015. Behavior toward domestic garbage treatment deteriorated (Table 5), due to a lack of management of garbage cans and classification processing.

Different groups of people had different behavioral changes, as shown in Figure 4. There is evidence that environmental management may affect environmental behavior. The two eco-villages (LSG and WZ) are equipped with facilities for sewage treatment, which contribute to the good performance of the behavior index. This is higher than for FMY, where no substantial improvement in wastewater infrastructure has been made. Men and women began to show a more balanced behavior index, with the increase in the female index and the decrease in the male index during the survey period.

Older people seemed to behave better than young people in 2015. Education played a vital role in the respondents' behavior. Compared with people with a low education level, respondents with a high school education and above had a higher environmental behavior index than those with a junior high school and below education level.

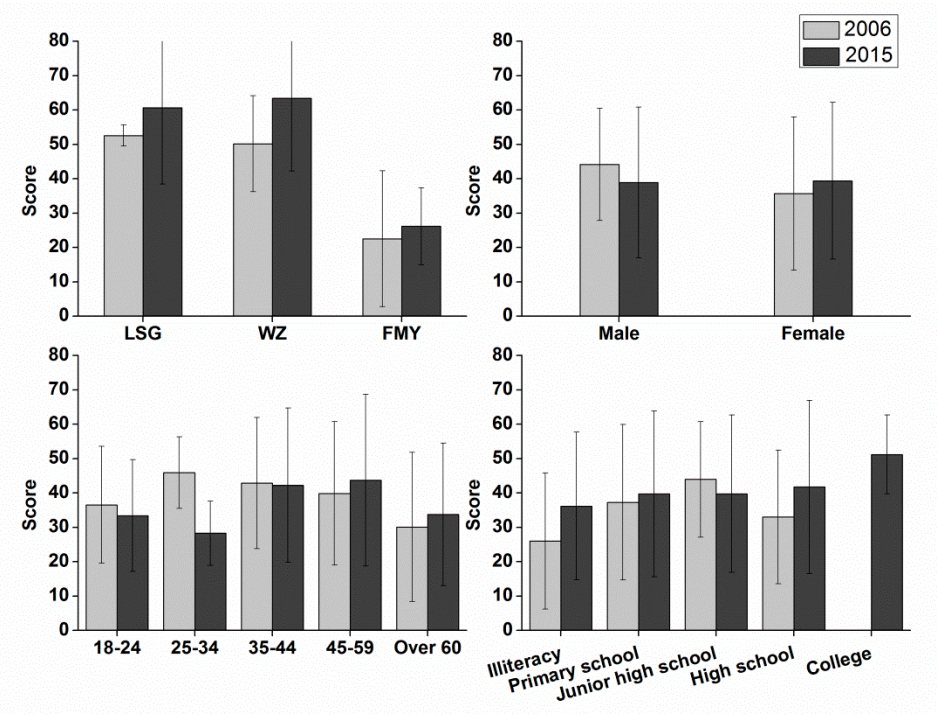

Figure 4. Environmental behavior index.

4.3.1. Wastewater Treatment

In many rural areas, wastewater treatment is rare. Wastewater is very often directly released into fresh water bodies. Many households in the rural parts of Beijing do not have public sewers, and must therefore depend on on-site treatment systems, such as infiltration pools and septic tanks, or discharge directly into watercourses, yards, streets, or other places [54]. All of these behaviors contribute to environmental degradation for water, which often does not meet quality standards.

In October 2005, the Chinese government put forward the strategic plan "New Socialist Countryside Construction" [55]. Methods for improving the living environment and dealing with domestic wastewater in rural areas have remained an urgent concern for the China State Council and State Environment Protection Administration [54]. As a consequence, infiltration pools as a means of sewage treatment decreased sharply by 35.42%, and more people chose to discharge sewage into a sewer (17% to a sewer without treatment and 26.4% to a sewer with treatment). In spite of the sewage treatment facilities, most respondents did not change their behavior, and approximately half of the respondents still poured wastewater in their yard or on the street for convenience. This behavior causes pollutants to be carried into rivers with storm runoff. Clearly, many respondents could not realize the potential pollution resulting from this behavior.

4.3.2. Daily Garbage Treatment

The management of solid waste in rural areas is a major issue at present [56]. Rural solid waste is dominated by food residue, coal ash, etc. In China, rural solid waste for the most part is still randomly discarded without proceeding any treatment [57]. Garbage that goes into the trash can smell rotten because of a lack of effective management, such as sorting and timely clean up. Illegally dumped kitchen waste and decayed straw waste cause terrible smells (see Figure 5). This will also cause non-point source pollution due to rainfall erosion.

The results show that more than 50% of people threw garbage into the trash in 2006 and 2015, but the behavior of casually dumping rubbish has worsened, increasing from 24.8% in 2006 to 42.97% in 2015. Moreover, waste sorting reduced significantly, from 13.6% in 2006 to 1.56% in 2015. This clearly shows a huge deficiency in terms of waste management in the surveyed villages. From the interview data, we found that although the government advocates garbage sorting, the effect of relevant campaigns was not good and did not reach expected outcomes. Moreover, the considerable distance from trash cans in distance is discouraging people from using them. In fact, more and more people just throw rubbish in places such as dried-up river beds or by the roadside (Figure 5).

Figure 5. Phenomenon of dumped litter.

4.3.3. Feces Treatment

Human and animal manure is a valuable source of nutrients [58]. In 2005, traditional agriculture was the main industry in the surveyed area, and most people used manure as fertilizer, which caused the loss of nitrogen and phosphorus, eventually resulting in water eutrophication. Following the

principles of sustainable development and the ensuing evolution of agricultural practices, and due to the efficiency and convenience of chemical fertilizer use, the results show that the application of human and animal feces as fertilizer has dramatically decreased from 88% in 2006 to 34.92% in 2015 (See Table 9). This decreased non-point source pollution runoff from the surface. Therefore, manure is dealt with by special personnel who clean it up, instead of directly disposing it as agricultural fertilizer.

Table 9. Environmental behaviors.

Question	Options	2006	2015
How do you normally deal with wastewater, such as washing water, etc.?	Splashed somewhere conveniently	48.8%	49.6%
	Pour into infiltration pool	42.4%	7.0%
	Sewage pipes (no treatment)	7.2%	17.1%
	Sewage pipes (with treatment)	1.6%	26.4%
How do you normally deal with domestic garbage?	Throw about conveniently	24.8%	42.6%
	Throw in garbage can	61.6%	51.9%
	Dispose after sorted	13.6%	1.6%
	Other way	0	3.1%
How do you normally deal with human and animal waste?	Use as fertilizer	88%	34.1%
	Throw on the side of the road	2.4%	7.0%
	Throw in garbage can	1.6%	5.4%
	Pay someone to clean up	5.6%	20.2%
	Centralized treatment	1.6%	27.9%
	No treatment	0.8%	3.1%

4.4. Analysis of Changes in Water Quality Perception

The perception index of water quality increased from 35.16 to 47.56 as more people began to realize that the condition of the water environment was getting worse. Figure 6 shows a general increase in water perception between 2006–2015. Differences were found among the villages. People living in FMY had a higher index than people living in the other two villages. WZ and LSG had relatively better water quality than FMY.

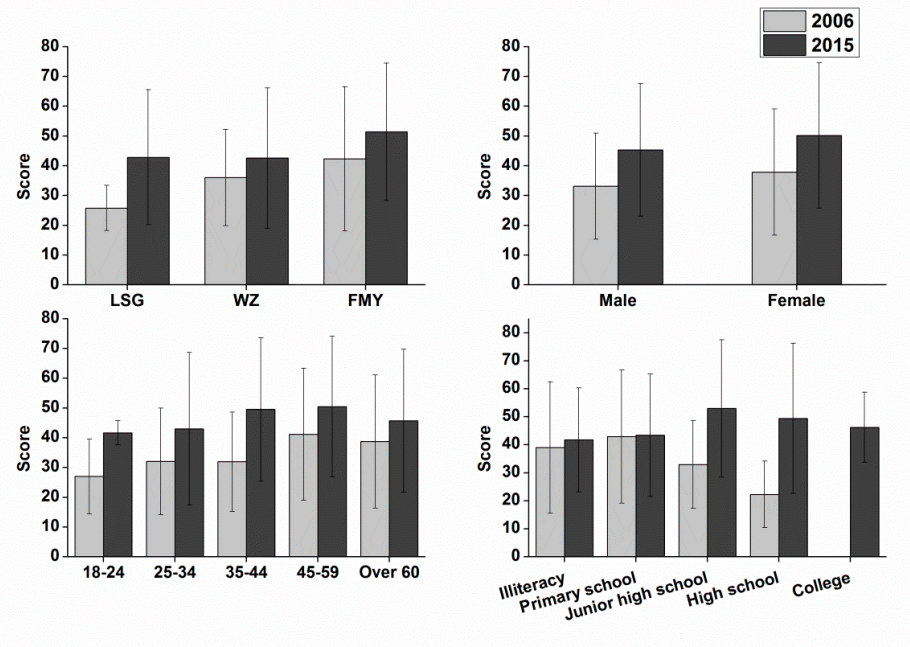

Figure 6. Water perception index.

On the other hand, the stream crossing FMY from north to south was characterized in 2015 by severe eutrophication and filled with garbage. Respondents living in FMY clearly judged water pollution from what they saw, and believed that water quality was not good. Females had a heightened perception compared with males. The results show that middle-aged and older respondents (over 35 years old) had a better perception than younger respondents (18–34 years old). The older respondents and females focused more on water environment, which is related to people's health. Also, villagers with a higher education level had a better knowledge of water pollution than those with a lower education level.

4.4.1. Perception of Water Quality

Table 6 showed that respondents' concern for the pollution situation has increased. The number of people who thought water quality was "normal" declined from 68.6% to 51.2% between 2006–2015. At the same time, the number of those who perceived water quality as poor increased from 8.0% (2006) to 23.3% (2015). People considering water pollution a serious or very serious issue increased from 27.2% to 45.7%. The number of villagers who were unclear about the pollution situation decreased by about 10%. Half of the respondents thought water was not polluted in 2006, which decreased to 40.3% in 2015. Results clearly show that respondents began to realize that water quality had seriously deteriorated between 2006–2015, though not all of them did. This may be because environmental information disclosure has only had a limited penetration among rural communities.

4.4.2. Source of Water Pollution

At the study sites, sources of diffuse water pollution includes runoff from agricultural land, which contains substances including pest control products, sewage sludge, and manure. In addition, both industrial enterprises and rural tourism can cause rural pollution. The villagers' awareness of the causes of water pollution changed dramatically between 2006–2015. About 60% of respondents in 2015 thought that wastewater and household garbage polluted river water, which was a higher proportion than in 2006 (40%).

Also, the improvement of living conditions produced more waste. Although infrastructure has developed, it still cannot entirely meet the needs of local residents. Combined with the inconsistent management of infrastructure, wastewater and domestic garbage are still a major problem in rural villages. In some areas, the economic development model shifted from traditional agriculture to agri-tourism. As such, while the use of pesticide chemical fertilizer has greatly reduced, new pollution sources have emerged. Agri-tourism was identified as a main source of pollution by 6.7% of respondents. In order to safeguard the Miyun Reservoir, local governments have restricted the development of in-house or refined animal production, but there are still some free-range livestock. Due to changes in the development of rural areas, livestock manure is no longer used as farmland fertilizer. However, improper disposal was a main source of pollution, according to 13.4% of respondents. The results show that the percentage of those who had no idea about the main pollution sources decreased by half, from 28.8% in 2006 to 14.0% in 2015. Answers provided in 2015 also reflect a change in major sources of water pollution, with new sources from eco-tourism facilities accounting for 6.2%.

4.4.3. Access to Environmental Information

Environmental awareness is affected by formal and informal education [59]. Environmental information is essential for rural residents to have an objective understanding of environmental conditions. Most respondents learned environmental information from different sources (Table 10).

The most common access was public media (71.2% in 2006 and 49.6% in 2015), such as television, internet, computer, and mobile phones. Compared with a decade ago, more people began to be concerned about environmental issues through their own initiative by communicating with others (3.2% in 2006 and 14.7% in 2015) or through their direct experience (meaning that it is directly experienced

through the senses of the interviewed person) (4.8% in 2006 and 15.5% in 2015), such as what they saw and what they feel about changes in environmental conditions. This is similar to research in developing countries where families and mass media were perceived of being the most common information source [60]. With reference to the government sector, government training is beginning to be a new source of information.

Table 10. Respondents' perception of water quality and pollution.

Question	Options	2006	2015
What do you think of the water quality?	General	68.8%	51.2%
	Good	23.2%	25.6%
	Poor	8%	23.3%
What do you think of the pollution situation?	Don't know	23.2%	14%
	Not polluted	49.6%	40.3%
	Slightly polluted	17.6%	24%
	Seriously polluted	9.6%	21.7%
What do you think is the main pollution source?	Domestic garbage	40.8%	60.5%
	Livestock manure	4.8%	13.4%
	Pesticide and chemical fertilizer	22.4%	7.6%
	Industry	3.2%	5%
	Agri-tourism		6.7%
	Don't know	28.8%	13.4%
How do you get environmental information?	No idea	4%	0.8%
	Trained by local government	0%	5.4%
	Publicity column	16.8%	14%
	Communicate with others	3.2%	14.7%
	direct experience	4.8%	15.5%
	Public media	71.2%	49.6%

4.5. Analysis of Changes in Attitude Toward Environmental Improvement

The attitude toward environmental improvement includes villagers' responsibility to improve the environment, attitude toward environmental protection measures, and willingness to pay for environmental protection. Figure 7 shows that female had a relatively positive attitude toward environmental improvement compared with males. The attitude toward environmental improvement in LSG decreased greatly. On-the-spot investigation and the interview showed that the main reason was that there was a large restaurant located just west of LSG. Wastewater from the restaurant made its way to the downstream village, resulting in water pollution. Therefore, respondents thought it was the restaurant that had to bear the responsibility for environmental improvement. This demonstrates that if a point source can be blamed as the major source of pollution, people might become less responsible, overlooking the impacts of their individual activities on the environment.

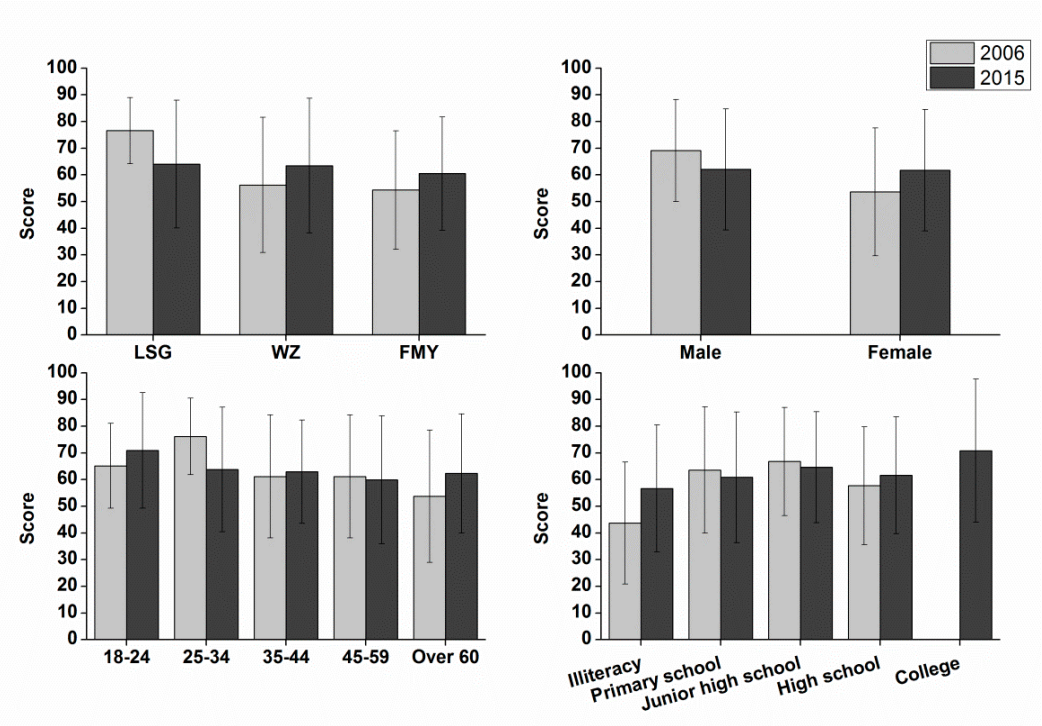

Figure 7. Environmental attitude index.

4.5.1. Responsibility to Improve the Environment

With reference to the issue of who should bear the responsibility of improving the environment, little change occurred over the 10 years considered in our study (Table 11). Those who thought environmental improvement should be the responsibility of both individuals and the government accounted for 63.2% in 2006 and 62.0% in 2015. Similarly, people who thought that government authorities should entirely bear this responsibility accounted for 31.2% in 2006 and 32.6% in 2015. Only about 5% of respondents thought there was no need to improve the environment. From these results, we can conclude that the idea that addressing environmental issues requires collective action (i.e., individuals and organizations, including government authorities) remains prevalent in the surveyed area.

4.5.2. Attitude Toward Environmental Protection Measures

Environmental protection measures are intended as measures implemented by government authorities to prevent and control non-point source water pollution. The number of respondents who would comply with the directives of local government and those who thought that government policy is not effective increased, while the number of those strongly supporting government policies decreased (Table 11). This suggests that more people have lost their initiative to improve water quality and would rely rather passively on the government to take action to protect the environment.

4.5.3. Changes in Willingness to Pay for Improvement in the Water Environment

In 2006, a substantial proportion of the respondents had relatively positive attitudes toward the payment of fees to pay for the improved management of the water environment (Table 11). Roughly 66.4% of respondents said that they were either willing to pay for government-provided services (40.8%), or just comply with the direction made by local government (25.6%). In 2015, no clear change was detected with reference to the willingness to pay (40.0%). However, the percentage of those who would follow government suggestions on the issue declined by 10% (down from 25.6% to 15%).

Conversely, the percentage of those who would rather follow the general trend (e.g., such as following the advice from family and friends) increased from 8.0% to 15.7%.

The reasons for the decrease in people's support of possible water management measures for which they would have to pay may vary. One of the factors impacting people's attitude could be declining confidence in the ability of the village committees. Moreover, a few interviewees commented that if they paid, they could not be sure that their money would be actually used for strengthening management of the water environment. This indicates both a lack of transparency in public information, and a lack of trust in government institutions.

Table 11. Attitude toward environmental improvement.

Question	Options	2006	2015
Who do you think should bear the responsibility to improve the environment?	No need to improve	5.6%	5.4%
	Improve by government	31.2%	32.6%
	Improve by individuals and society	63.2%	62%
What do you think of government's policy and environmental measures?	I oppose these measures	0.80%	2.3%
	I don't care about it	8.0%	7.8%
	Comply with the government's direction	20.0%	27.1%
	I support these measures	24.0%	24.0%
	I strongly support these measures	47.2%	38.0%
Would you pay some money to implement some measures for environmental protection?	Unwilling to pay	25.6%	26.8%
	Follow general trend (e.g., others' advice)	8%	15.7%
	Comply with the direction made by local government	25.6%	15%
	Willing to pay	40.8%	42.5%

5. Discussion

5.1. Factors Influencing Environmental Awareness

As shown in Table 12, in 2006, the total environmental awareness index had a negative correlation with the respondents' age, and a positive correlation with education level, responsibility to improve the environment, willingness to pay, and attitude toward environmental protection measures.

Females and older respondents both had a lower index. Conversely, the higher the education level, the higher the index. Attitude toward environmental improvement had a negative correlation with gender and age, while a positive correlation with education level and environmental behavior coincided. Environmental perception had a positive correlation with age, and a negative correlation with education level and environmental behavior.

In 2015, the total index of environmental awareness had no correlation with gender, age, and education level, while it maintained a positive correlation with environmental behavior and attitudes toward environmental improvement. Against a background of increasingly serious environmental problems, basic demographic characteristics appear to play a lesser role in predicting environmental awareness, if compared with the past. The responsibility to improve the environment, willingness to pay, and attitude toward protective measures, all had a positive correlation with the total indexes in both 2006–2015.

As previously discussed, demographics no longer are the main factors influencing environmental awareness. More attention should be put into nurturing positive environmental behavior, perception, and attitudes toward improving environment quality.

Table 12. Correlation between variables.

Year	Variables	G	A	EL	EB	EP	EA
2006	G	1					
	A	−0.028	1				
	EL	−0.193 *	−0.478 **	1			
	EB	−0.143	−0.099	0.158	1		
	EP	0.117	0.190 *	−0.253 **	−0.324 **	1	
	EA	−0.324 **	−0.213 *	0.208 *	0.261 **	0.068	1
	TS	−0.288 **	−0.223 *	0.188 *	0.320 **	0.152	0.964 **
2015	G	1					
	A	−0.069	1				
	EL	0	−0.478 **	1			
	EB	0.002	−0.107	0.013	1		
	EP	0.105	0.041	0.134	−0.119	1	
	EA	−0.002	−0.057	0.101	0.129	−0.11	1
	TS	0.038	−0.07	0.109	0.266 **	−0.058	0.950 **

G: Gender; A: Age; EL: Education level; EB: Environmental behavior; EP: Environmental perception; EA: Environmental Attitude; TS: Total score * Significant at the 0.05 level; ** Significant at the 0.01 level.

5.2. The Connection between Environmental Behavior and Rural Infrastructure

Environmental awareness was found to be positively associated with environmental practices [61] and policy. Infrastructure, which in the context of our survey is a crucial element in facilitating rural development, plays an important role in shaping environmental behavior. We observed in particular a transition of rural sewage treatment, which took the place of traditional infiltration pools, and therefore reduced the risk of water pollution. However, sewage treatment in rural areas remains rare due to insufficient financial resources, and environmental protection is adopted half-heartedly. Due to the imperfect infrastructure, the phenomenon of pouring wastewater everywhere has not changed, and nearly half of the villagers investigated in our survey still poured wastewater into the yard or on the street. Another issue is the management of domestic garbage. In rural areas, the number of trash cans is limited, and these cannot be quickly emptied, causing possible non-point source pollution by surface runoff. Empirical study of the contribution of infrastructure to the coordinated development between urban and rural areas has shown that in cases where the investment in rural infrastructure is similar to the one in the urban area [62], then the rural residents' environmental-related behavior will greatly change. Environmental remediation in peri-urban areas has triggered as well similar processes of change in beliefs orienting the relationship between local communities and nature [56].

5.3. The Connection between Environmental Perception and Information Disclosure

Different studies have explored the relationship between stakeholders' environmental awareness and their support for environmental protection [28]. Environmental perception, which is intended as one's understanding of the natural environment and of the pollution issues affecting it, is of great importance in this regard. An important example in China is the one of air pollution, whereby plenty of information can be obtained through a variety of sources (both governmental and independent) and by means of a wide array of media. In this respect, both government-led information disclosure and the civil society have played a positive role. This has had a deep impact on public awareness of air pollution: in fact, many in China have a fairly detailed understanding of the influence of air pollution on human health, which translates into willingness to pay for the improvement for air quality [23,63].

In the case considered by the present study, perceptions of the residents were highly influenced by what they observed or smelled. However, residents had no idea of the water quality monitoring results [33,34]. On this note, the National Public Environmental Awareness Report in 2007 showed that respondents had a heightened environmental perception, but low correctness ratios. Although progress has been made in recent years [64,65], access to accurate information among rural communities remains limited.

The relatively scarce knowledge on water environment protection impacts negatively on the Chinese public awareness, as well as on public participation. The role of public participation in environmental management has in fact been very weak [22], and considerable room for improvement remains at this regard [66]. Information disclosure is a vital factor influencing respondents' environmental awareness.

5.4. The Connection between Environmental Attitude and Local Environmental Governance

Environmental governance engages multiple stakeholders, who must collaborate in the pursuit of a common interest. Since the 1970s, environmental protection has become one of the core tasks of the government. The central government of China, along with local governments and agencies responsible for policy implementation in related sectors, began to give more priority to environmental concerns for policy-making [1,8]. Establishing trust is essential to effective governance and shared decision-making [64]. Local institutions play a large role in this respect. On the one hand, local authorities have an important role in shaping local environmental awareness, and therefore on environmental protection attitudes [36]. On the other hand, their capacity to communicate both environmental issues and measures taken to mitigate them clearly and transparently is the key to strengthening the credibility of government authorities and people's trust in them. In turn, a higher level of trust would eventually translate into a higher willingness of respondents to support environmental management measures [37,38].

Empirical evidence suggests that two-way communication between government and communities would be the most efficient way to build residents' trust in government. The establishment of government information disclosure and of meaningful public feedback mechanisms could enhance residents' support of and participation in rural environmental improvement [36]. In fact, residents' perceptions of the costs and benefits of environmental management and their trust in government are significant determinants of political support [65].

Although the issue is not thoroughly analyzed in the present study, it is nonetheless worth noting that during our investigation, we found anecdotal evidence suggesting that distrust in government may be a major reason behind respondents' unwillingness to pay for environmental improvement. In fact, those people who were not in favor of paying for environmental improvement said they were uncertain whether their money would be used for the asserted purpose or not. Clearly, such a lack of trust would significantly hinder residents' enthusiasm to contribute to environmental protection using their human, material, and financial resources.

6. Conclusions

AHP results show that environmental attitudes have a weight of 0.5 in environmental awareness, a weight of 0.33 for environmental behavior, and a weight of 0.17 for environmental awareness. This shows that environmental attitude is the most important. It is the most authentic expressions from the innermost being; attitudes dominate behaviors, and behaviors respond to attitudes, so the importance of environmental behaviors is second to environmental attitude. Environmental perception is influenced by external conditions.

Environmental awareness in the Miyun improved between 2006–2015. This change is evident in terms of both environmental behavior and environmental perception. However, there was no significant improvement of environmental attitude. Villagers' deeper environmental perceptions did not translate into a positive attitude toward environmental management. Respondents do recognize environmental degradation and acknowledge the need to take action to solve or at least mitigate it. However, eventually, when it comes to willingness to pay for environmental management measures, they appear to show skepticism for the government to some extent. Although all of the villages showed an improvement in terms of environmental awareness, the improvement in villages with a better environmental management (i.e., the eco-villages) was more considerable than that detected in villages with a comparatively worse environmental management (i.e., the agri-villages). There is considerable room for improvement in terms of awareness. To improve it, local government should

strengthen environmental infrastructures, and increase the disclosure of environmental information to inform people about environmental conditions and relevant policies. In order to ensure public support and participation in environmental protection, local authorities should also focus on strengthening their credibility in the eyes of local communities.

Funding: Funding for this research has been provided by the National Natural Science Foundation of China (No. 41271495), and Newton Fund (Grant Ref: BB/N013484/1), UK, and Capital Normal University International Communication and Joint Training Programs (No.028175534000).

Acknowledgments: The authors' list has been determined based on a Sequence Determines Credit (SDC) approach. Authors wish to thank the anonymous reviewers for their comments. Partial support was given by GLOCOM project restricted to authors affiliated with University Ca' Foscari of Venice, Italy for their stay in China. Authors wish to thank Faith Chan, University of Nottingham Ningbo, China for his valuable comments.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Li, W.; Mauerhofer, V. Behavioral Patterns of Environmental Performance Evaluation Programs. *J. Environ. Manag.* **2016**, *182*, 429–435. [CrossRef] [PubMed]
2. Kokkinen, E. *Measuring Environmental Awareness in the World*; University of Oulu: Oulu, Finland, 2013.
3. Zhang, B.; Cao, C.; Hughes, R.M.; Davis, W.S. China's New Environmental Protection Regulatory Regime: Effects and Gaps. *J. Environ. Manag.* **2017**, *187*, 464–469. [CrossRef] [PubMed]
4. Wang, L. The Changes of China's Environmental Policies in the Latest 30 Years. *Procedia Environ. Sci.* **2010**, *2*, 1206–1212. [CrossRef]
5. Lu, Y.; Abeysekera, I. Stakeholders' Power, Corporate Characteristics, and Social and Environmental Disclosure: Evidence From China. *J. Clean. Prod.* **2014**, *64*, 426–436. [CrossRef]
6. Zhang, X.; Chen, C.; Lin, P.; Hou, A.; Niu, Z.; Wang, J. Emergency Drinking Water Treatment during Source Water Pollution Accidents in China: Origin Analysis, Framework and Technologies. *Environ. Sci. Technol.* **2011**, *45*, 161–167. [CrossRef] [PubMed]
7. Tian, Y.; Wang, C. Environmental Education in China: Development, Difficulties and Recommendations. *J. Soc. Sci. Stud.* **2015**, *31*, 31. [CrossRef]
8. Tian, X.-L.; Guo, Q.-G.; Han, C.; Ahmad, N. Different Extent of Environmental Information Disclosure Across Chinese Cities: Contributing factors and correlation with local pollution. *Glob. Environ. Chang.* **2016**, *39*, 244–257. [CrossRef]
9. Fryxell, G.E.; Lo, C.W.H. The Influence of Environmental knowledge and values on managerial behaviours on behalf of the environent an empirial examination of Managers in China. *J. Bus. Eth.* **2003**, *46*, 45–69. [CrossRef]
10. Liu, L.; de Jong, M.; Huang, Y. Assessing the Administrative Practice of Environmental Protection Performance Evaluation in China: The Case of Shenzhen. *J. Clean. Prod.* **2016**, *134*, 51–60. [CrossRef]
11. Xi, W. A Study on China's System of Public Participation in Environmental Protection—Taking Haikou's "Two Constructions" for Example. *IOP Conf. Ser. Earth Environ. Sci.* **2017**, *51*, 012012. [CrossRef]
12. CECPA (China Environment Culture Promotion Association). *China's Public Environmental Protection Index*; CECPA: Beijing, China, 2008.
13. Zhang, X.; Wang, Y.; Qi, Y.; Wu, J.; Liao, W.; Shui, W.; Zhang, Y.; Deng, S.; Peng, H.; Yu, X.; et al. Evaluating the Trends of China's Ecological Civilization Construction Esing a Novel Indicator System. *J. Clean. Prod.* **2016**, *133*, 910–923. [CrossRef]
14. Wang, X.; Feng, Q.; Zhang, Y.; Duan, S.; Novotny, V. Public Perceptions and Support of Environmental Management in the Source Area of Drinking Water for Beijing, China. *Environ. Eng. Res.* **2010**, *151*, 49–56. [CrossRef]
15. Ding, Z.; Hong, S.; Dong, S.; Hu, T.; Liu, Z. Public Investigations on Monitoring Systemof Water Pollution Control in Huaihe and Taihu Regions. *Environ. Prot. Sci.* **2007**, *336*, 97–99. (In Chinese)
16. Xu, D.; Chang, L.; Hou, T.; Zhao, Y. Measure of Watershed Ecological Compensation Standard Based on WTP and WTA: A case study in Liaohe River Basin. *Resour. Sci.* **2012**, *347*, 1354–1361. (In Chinese)
17. Luan, Y.; Liu, J.; Deng, J.; Zeng, B. Analysis and Evaluation of Public Participation in Water Resources Management of Baiyangdian Basin, China. *Res. Environ. Sci.* **2010**, *236*, 703–710. (In Chinese)

18. Yan, G.; Kang, J.; Wang, G.; Lin, H.; Zhu, J.; Liu, C.; Sun, W.; Li, Y.; Jin, T. Change Trend of Public Environmental Awareness in Shanghai (2007 to 2011). *Energy Procedia* **2012**, *16*, 715–721. [CrossRef]
19. Shao, F.; Wang, Y.; Wang, H. Investment on Environmental Awareness of College Students in Jinan. *Environ. Sci. Manag.* **2010**, *359*, 152–157. (In Chinese)
20. Lv, J.; Chen, T.; Liu, L. An Investigation and Analysis of Tourists Environmental Consciousness. *Geogr. Res.* **2009**, *281*, 259–270. (In Chinese)
21. Lv, J.; Liu, L. Analysis of Environmental Awareness Level of Community Residents in the Development of Grassland Tourism. *Chin. Rural Econ.* **2008**, *01*, 40–49. (In Chinese)
22. Chen, M.; Qian, X.; Zhang, L. Public Participation in Environmental Management in China: Status Quo and Mode Innovation. *Environ. Manag.* **2015**, *553*, 523–535. [CrossRef] [PubMed]
23. Wang, Y.; Sun, M.; Yang, X.; Yuan, X. Public Awareness and Willingness to Pay for Tackling Smog Pollution in China: A Case Study. *J. Clean. Prod.* **2016**, *112*, 1627–1634. [CrossRef]
24. Qin, H. Rural-to-Urban Labor Migration, Household Livelihoods, and the Rural Environment in Chongqing Municipality, Southwest China. *Hum. Ecol.* **2010**, *385*, 675–690. [CrossRef] [PubMed]
25. Anderson, B.A.; Romani, J.H.; Phillips, H.E.; Wentzel, M.; Tlabela, K. *Exploring Perceptions, Behaviors and Awareness: Water and Water Pollution in South Africa*; Population Studies Center Research Report; University of Michigan: Ann Arbor, MI, USA, 2006; pp. 1–30.
26. Liu, X.; Vedlitz, A.; Shi, L. Examining the Determinants of Public Environmental Concern: Evidence from National Public Surveys. *Environ. Sci. Policy* **2014**, *39*, 77–94. [CrossRef]
27. Mei, N.S.; Wai, C.W.; Ahamad, R. Environmental Awareness and Behaviour Index for Malaysia. *Procedia Soc. Behav. Sci.* **2016**, *222*, 668–675. [CrossRef]
28. Umuhire, M.L.; Fang, Q. Method and Application of Ocean Environmental Awareness Measurement: Lessons Learnt From University Students of China. *Mar. Pollut. Bull.* **2016**, *1022*, 289–294. [CrossRef] [PubMed]
29. Sullivan, S.; Erickson, D.; Young, R.K.D. Environmental Awareness, Economic Orientation, and Farming Practices: A Comparison of Organic and Conventional Farmers. *Environ. Manag.* **1997**, *215*, 747–748.
30. Marcinkowski, T.J. An analysis of Correlates and Predictor of Responsible Environmental Behavior. *Diss. Abstr. Int.* **1988**, *1249*, 3677-A.
31. Yusof, N.A.; Zainul Abidin, N.; Zailani, S.H.M.; Govindan, K.; Iranmanesh, M. Linking the Environmental Practice of Construction Firms and the Environmental Behaviour of Practitioners in Construction Projects. *J. Clean. Prod.* **2016**, *121*, 64–71. [CrossRef]
32. Ruepert, A.; Keizer, K.; Steg, L.; Maricchiolo, F.; Carrus, G.; Dumitru, A.; García Mira, R.; Stancu, A.; Moza, D. Environmental Considerations in the Organizational Context: A Pathway to Pro-environmental Behaviour at Work. *Energy Res. Soc. Sci.* **2016**, *17*, 59–70. [CrossRef]
33. Vincenzi, S.L.; Possan, E.; de Andrade, D.F.; Pituco, M.M.; de Oliver Santos, T.; Jasse, E.P. Assessment of Environmental Sustainability Perception Through Item Response Theory: A Case Study in Brazil. *J. Clean. Prod.* **2018**, *170*, 1369–1386. [CrossRef]
34. Johnson, B.G.; Faggi, A.; Voigt, A.; Schnellinger, J.; Breuste, J. Environmental Perception Among Residents of a Polluted Watershed in Buenos Aires. *J. Urban Plan. Dev.* **2005**, *141*. [CrossRef]
35. Kil, N.; Holland, S.M.; Stein, T.V. Structural Relationships Between Environmental Attitudes, Recreation Motivations, and Environmentally Responsible Behaviors. *J. Outdoor Recreat. Tour.* **2014**, *7–8*, 16–25. [CrossRef]
36. Chen, W.Y.; Hua, J. Citizens' Distrust of Government and Their Protest Responses in a Contingent Valuation Study of Urban Heritage Trees in Guangzhou, China. *J. Environ. Manag.* **2015**, *155*, 40–48. [CrossRef] [PubMed]
37. Ane, P. An Assessment of the Quality of Environmental Information Disclosure of Corporation in China. *Syst. Eng. Procedia* **2012**, *5*, 420–426. [CrossRef]
38. Blackstock, K.L.; Ingram, J.; Burton, R.; Brown, K.M.; Slee, B. Understanding and Influencing Behaviour Change by Farmers to Improve Water Quality. *Sci. Total Environ.* **2010**, *40823*, 5631–5638. [CrossRef] [PubMed]
39. Hu, D.; Wang, R. Exploring Eco-construction for Local Sustainability: An Eco-village Case Study in China. *Ecol. Eng.* **1998**, *11*, 167–176. [CrossRef]
40. Geng, R.; Wang, X.; Sharpley, A. Developing and Testing a Best Management Practices Tool for Estimating Effectiveness of Nonpoint Source Pollution Control. *Environ. Earth Sci.* **2015**, *744*, 3645–3659. [CrossRef]

41. Islam, M.T.; Abdullah, A.B.; Shahir, S.A.; Kalam, M.A.; Masjuki, H.H.; Shumon, R.; Rashid, M.H. A Public Survey on Knowledge, Awareness, Attitude and Willingness to Pay for WEEE Management: Case Study in Bangladesh. *J. Clean. Prod.* **2016**, *137*, 728–740. [CrossRef]
42. Morgan, R. An Investigation of Constraints Upon Fisheries Diversification Using the Analytic Hierarchy Process (AHP). *Mar. Policy* **2017**, *86*, 24–30. [CrossRef]
43. Saaty, T.L. How to Make a Decision: The Analytic Hierarchy Process. *Eur. J. Oper. Res.* **1990**, *48*, 9–26. [CrossRef]
44. Saaty, T.L. Rank from Comparisons and From Ratings in the Analytic Hierarchy/Network Processes. *Eur. J. Oper. Res.* **2006**, *1682*, 557–570. [CrossRef]
45. Qiu, J.; Shen, Z.; Chen, L.; Xie, H.; Sun, C.; Huang, Q. The Stakeholder Preference for Best Management Practices in the Three Gorges Reservoir Region. *Environ. Manag.* **2014**, *545*, 1163–1174. [CrossRef] [PubMed]
46. Rezadoost, B.; Allahyari, M.S. Farmers' Opinions Regarding Effective Factors on Optimum Agricultural Water Management. *J. Saudi Soc. Agric. Sci.* **2014**, *131*, 15–21. [CrossRef]
47. Banister, J.; Bloom, D.E.; Rosenberg, L. *Population Aging and Economic Growth in China*; PGDA Working Paper No. 53; Program on the Global Demography of Aging: Boston, MA, USA, 2010.
48. Bogner, F.X.; Wiseman, M. Environmental Percetion of Rural and Urban Pupils. *J. Environ. Psychol.* **1997**, *172*, 111–122. [CrossRef]
49. Hirsh, J.B. Personality and Environmental Concern. *J. Environ. Psychol.* **2010**, *302*, 245–248. [CrossRef]
50. Mukhamedova, N.; Wegerich, K. The Feminization of Agriculture in Post-Soviet Tajikistan. *J. Rural Stud.* **2018**, *57*, 128–139. [CrossRef]
51. Hunter, L.M.; Hatch, A.; Johnson, A. Cross-National Gender Variation in Environmental Behaviors. *Soc. Sci. Q.* **2004**, *853*, 677–694. [CrossRef]
52. Zhou, J.-B.; Zou, J. The Evaluation and Influence Factor of Beijing's Public Environmental Awareness. *Soc. Sci. Beijing* **2005**, *2*, 128–133. (In Chinese)
53. Morren, M.; Grinstein, A. Explaining Environmental Behavior Across Borders: A Meta-Analysis. *J. Environ. Psychol.* **2016**, *47*, 91–106. [CrossRef]
54. Shubiao, W.; David, A.; Lin, L.; Renjie, D. Performance of Integrated Household Constructed Wetland for Domestic Wastewater Treatment in Rural Areas. *Ecol. Eng.* **2011**, *376*, 948–954.
55. Ahlers, A.L.; Schubert, G. "Building a New Socialist Countryside"—Only a Political Slogan? *J. Curr. Chin. Aff.* **2009**, *38*, 35–62.
56. Suraj, A.; Sutar, S.M.G. Solid Waste Management in Rural Areas Emerging Towards Growth Centre Through GIS SystemMahalung, Solapur. *Int. J. Sci. Res.* **2015**, *47*, 475–478.
57. Zeng, C.; Niu, D.; Zhao, Y. A Comprehensive Overview of Rural Solid Waste Management in China. *Front. Environ. Sci. Eng.* **2015**, *96*, 949–961. [CrossRef]
58. Cordell, D.; Rosemarin, A.; Schroder, J.J.; Smit, A.L. Towards Global Phosphorus Security: A Systems Framework for Phosphorus Recovery and Reuse Options. *Chemosphere* **2011**, *846*, 747–758. [CrossRef] [PubMed]
59. Buzov, I. Social Network Sites as Area for Students' Pro-environmental Activities. *Procedia Soc. Behav. Sci.* **2014**, *152*, 1233–1236. [CrossRef]
60. Noorhosseini, S.A.; Allahyari, M.S.; Damalas, C.A.; Moghaddam, S.S. Public Environmental Awareness of Water Pollution From Urban Growth: The Case of Zarjub and Goharrud Rivers in Rasht, Iran. *Sci. Total Environ.* **2017**, *599–600*, 2019–2025. [CrossRef] [PubMed]
61. Gadenne, D.L.; Kennedy, J.; McKeiver, C. An Empirical Study of Environmental Awareness and Practices in SMEs. *J. Bus. Eth.* **2008**, *84*, 45–63. [CrossRef]
62. Jiang, S.; Shen, L.; Zhou, L. Empirical Study on the Contribution of Infrastructure to the Coordinated Development between Urban and Rural Areas: Case Study on Water Supply Projects. *Procedia Environ. Sci.* **2011**, *11*, 1113–1118.
63. Sun, C.; Yuan, X.; Xu, M. The Public Perceptions and Willingness to Pay: From the Perspective of the Smog Crisis in China. *J. Clean. Prod.* **2016**, *112*, 1635–1644. [CrossRef]
64. Dobbie, M.F.; Brown, R.R.; Farrelly, M.A. Risk Governance in the Water Sensitive City: Practitioner Perspectives on Ownership, Management and Trust. *Environ. Sci. Policy* **2016**, *55*, 218–227. [CrossRef]

65. Nunkoo, R.; Smith, S.L.J. Political Economy of Tourism: Trust in Government Actors, Political Support, and Their Determinants. *Tour. Manag.* **2013**, *36*, 120–132. [CrossRef]
66. Deng, Y.; Brombal, D.; Farah, P.; Moriggi, A.; Critto, A.; Zhou, Y.; Marcomini, A. China's Water Environmental Management towards Institutional Integration. A Review of Current Progress and Constraints vis-a-vis the European Experience. *J. Clean. Prod.* **2016**, *113*, 285–298. [CrossRef]